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ABSTRACT

These student and teacher guides are designed for a secondary-level course in natural resources that focuses on renewable and nonrenewable natural resources, methods of protecting the environment, and the various careers and technologies available in the natural resources area. The following topics are covered in the course's 10 units: outdoor safety and first aid, natural resources and conservation, water resource management, land management, air resource management, energy resources, forestry, wildlife management, wildlife habitats, and outdoor recreation. Each unit in the student guide contains some or all of the following: objective sheets, information sheets, student supplements, assignment sheets, and job sheets the last two of which are contained in the student workbook. The teacher edition and teacher component portion of the accompanying CD-ROM contain some or all of the following: how to use this product; competency profile; crosswalk to the Oklahoma Natural Resource Duty/Task List; instructional/task analysis; basic skill icons and classifications; basic skills matrix; tools, equipment, and materials lists; glossary of terms; and course units. Each unit in the teacher edition contains some or all of the following: suggested activities and lesson plans; answers to reviews, assignment sheets, and written tests; written tests; teacher supplements; and transparency forms. In addition to teacher components, the accompanying CD-ROM includes the following student components: objective sheet, information sheet, assignment sheet, and job sheet. (MO)

ED 480 827

Introduction to Natural Resources

Third Edition

Teacher Edition

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INFORMATION CENTER (ERIC)

2B

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Units of
Instruction

Unit 1:	Outdoor Safety and First Aid
Unit 2:	Natural Resources and Conservation
Unit 3:	Water Resource Management
Unit 4:	Land Management
Unit 5:	Air Resource Management
Unit 6:	Energy Resources
Unit 7:	Forestry
Unit 8:	Wildlife Management
Unit 9:	Wildlife Habitats
Unit 10:	Outdoor Recreation

Introduction to Natural Resources

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Introduction to Natural Resources

How to Use This Product

Introduction to Natural Resources is available in both a teacher and student edition. For the teacher edition, teacher components are provided on a CD-ROM and are accompanied by copies of the print student guide and workbook. The student guide is spiral-bound, and the student workbook is perfect-bound with the pages perforated for easy removal. Each are divided into units of instruction that may be broken into more than one lesson or class period.

MAVCC instructional materials are competency-based, and units of instruction are designed for use in more than one lesson or class period. Careful study of each unit of instruction and the suggested lesson plan by the teacher will help to determine the following:

- Amount of material that can be covered in each class period;
- Supplies and materials required for assignment sheets and job sheets;
- Resource people who may be contacted to reinforce instruction and/or demonstrate procedures;
- Amount of time needed for students to research topics on Internet/use of computer lab; and
- Amount of class time needed for students to complete assignment sheets and job sheets.

Teachers are encouraged to supplement, localize and personalize these materials to meet the needs of individual students.

Teacher Edition

The following introductory materials are included on the CD-ROM and contain useful information to assist teachers and administrators in planning for instruction. They are saved in PDF format and may be printed as needed.

- **How to use this product**—Explains the components of a unit of instruction and how they should be used as part of the teaching/learning process.
- **Competency profile**—This form may be used "as is" or may be modified by using the Word file included on the CD. It provides a record of student performance for each task included in a unit of instruction. This becomes a part of the student's permanent records and may be utilized when directing the student toward employment opportunities.
- **Crosswalk**—Aligns tasks covered in student materials to Oklahoma Natural Resources Duty/Task List.
- **Instructional/task analysis**—Provides a quick review of contents of the product; identifies cognitive (knowledge) skills and psychomotor (doing) skills addressed in each unit of instruction.
- **Basic skills icons and classifications**—Provides a reference guide of the graphic symbols that are used to identify the basic academic and workplace skills included in each assignment sheet and job sheet.

How to Use This Product

- **Basic skills matrix**—This document graphically summarizes the academic and workplace skills training included in the instructional materials, unit by unit. It should be helpful to teachers in planning for instruction, and to administrators as documentation that basic skills are being taught as part of the course.
- **Tools, equipment and materials list**—Provides a comprehensive list of those items needed to successfully complete the assignment sheets and/or job sheets; assists the teacher/administrator in determining program costs.
- **Glossary of terms**—Provides a summary of terms and definitions that are introduced as “key terms” in the Information Sheets.

The following teacher components are included for each unit of instruction and are provided in PDF format on the CD.

Note: The teacher edition may be printed in its complete version or by unit of instruction.

- **Suggested Activities.** This component assists teachers during the preparation stage of the teaching/learning process by providing an instructional plan, teaching suggestions, a list of resources used in the development of each unit of instruction, and a list of suggested supplemental resources (books, posters, videotapes, Internet sites) that may be used to enhance instruction. Time should be allowed to obtain supplemental materials, prepare audiovisual materials, and contact outside resources.

Instructions for evaluating student performance are also provided in this component.

- **Suggested Lesson Plan.** This document is provided for each unit of instruction and is divided into daily lessons that may be implemented “as is” or modified by using the Word file included on the CD.
- **Unit Review.** This new tool provides multiple choice test items that address cognitive objectives presented in the Information Sheet and may be used “as is” or modified to add/delete test items by using the Word file included on the CD. The unit review may be used for practice only or as part of the students’ evaluation.
- **Review—Answer Key.** Correct answers are indicated in bold for easy evaluation. If test items are added/deleted, the answer key should be modified by using the Word file included on the CD.
- **Teacher Supplements.** These are optional for the teacher to use. They have three purposes: to provide the teacher with higher level materials to stretch the advanced student; to provide all students with additional activities that enhance the learning process through hands-on experiences; and to provide the teacher with current information in which they may not otherwise have access to. Teacher supplements may be copied for student use.

How to Use This Product

- **Answers to Assignment Sheets.** This component is designed to assist the teacher in evaluation of student performances. Answer keys are provided as appropriate.
- **Written Test.** This assessment instrument provides criterion-referenced evaluation of every cognitive objective listed in the unit of instruction. It may be printed "as is" for student use, or modified to add/delete test items by using the Word file included on the CD. Tests may be divided into quizzes covering three or four objectives at a time, and test items from the units may be used for final tests at the end of each term if desired.
- **Written Test Answer Key.** This component is designed to assist the teacher in evaluation of student performances. Answers are noted in bold. If test items are added/deleted, the answer key should be modified by using the Word file included on the CD.
- **Transparency Masters.** Illustrations, charts, and additional information are provided as TMs to direct students' attention to the topic of classroom discussion and to clarify and reinforce objectives included in the unit of instruction.

Electronic Presentations

The transparency masters for each unit of instruction have been prepared as a PowerPoint® presentation and may be used "as is" or may be modified by teacher to include additional information/illustrations.

Student Edition

The following components are included in the student guide:

- **Objective Sheet.** This component is based on established performance objectives that state the goals for successful completion of a unit of instruction. Objectives are stated in two forms: unit objectives that state the expected performance of each student after completion of the unit and specific (enabling) objectives that state what the student must be able to do to reach the unit objective.

The objectives can help determine teaching strategies and instructional methods and should be stressed throughout the teaching/learning process.

Teachers should add or delete objectives in order to meet the needs of the students and community. When objectives are added, the teacher should remember to supply the needed information, assignment and/or job sheets, and criterion-referenced test items and answers to cover the new objectives.

How to Use This Product

- **Information Sheet.** This component provides the student with the essential information for meeting the cognitive objectives in the unit. Teachers will find that the information sheet serves as an excellent guide for presenting background knowledge necessary to develop the skills specified in the unit objective. Students should read the information sheet before the objectives are covered in class.
- **Student Supplements.** The information presented in a student supplement may consist of tables, charts, written information, forms, or other information students will need to complete one or more of the assignment and/or job sheets. Students are not directly tested over the information presented in a supplement; however, their ability to apply this information may be evaluated in the completion of a task.

The following components are included in the student workbook:

- **Assignment Sheets.** The assignment sheets provide students with an opportunity to use higher-order thinking skills, such as problem solving, synthesizing, analyzing, and evaluating. In addition, they may provide additional opportunities for students to develop their language and interpersonal relations skills.

Assignment sheets may be paper-and-pencil activities, as well as those using the computer for research or other resources as appropriate. Criteria are provided to evaluate student performance objectively, and basic academic and workplace skill icons appear on each assignment sheet to indicate which skills are integrated/ reinforced through completion of the activity.

Note: When a student is ready to be evaluated, the teacher should follow the instructions for evaluating student performance that may be found in the "Suggested Activities" component of the teacher unit.

- **Job Sheets.** Job sheets are an important segment of each unit and are designed as skill tests. Basic academic and workplace skill icons appear on each job sheet to indicate which skills are integrated/reinforced through completion of the job sheet. Criteria to objectively evaluate student performance, a list of required equipment and materials, and a step-by-step procedure for performing a psychomotor skill are also included. The teacher should discuss the equipment and materials available in the classroom or lab and explain/demonstrate the procedure prior to having students complete the activity.

Note: When a student is ready to be evaluated, the teacher should follow the instructions for evaluating student performance that may be found in the "Suggested Activities" component of the teacher unit.

Introduction to Natural Resources

Competency Profile

Student Information

Course _____ Instructor _____

Student Name _____

Grade _____

Allergies/Disabilities that might require special accommodation for training (please specify)

In case of emergency, contact _____ Phone _____

Student Evaluation

Directions: Evaluate the student using the rating scale below. Write the appropriate number to indicate the degree of competency achieved. The descriptions associated with each of the numbers focuses on a level of student performance for each of the tasks listed. The written test scoreline is provided for optional teacher use. It may not be applicable in all cases.

Rating Scale: Option A

- 4 Skilled—Can perform job with no additional training
- 3 Moderately Skilled—Has performed job during training program; limited additional training may be required.
- 2 Limited Skill—Has performed job during training program; additional training is required to develop skill.
- 1 Unskilled—Is familiar with process, but is unable to perform job.
- 0 No Exposure—No information or practice provided during training program, complete training required.
- NA Non-applicable.

Rating Scale: Option B

- Yes—Can perform with no additional training
- No—Is unable to perform satisfactorily

Unit 1: Outdoor Safety and First Aid

- _____ 1. Read wind chill index and water survival charts
- _____ 2. Interpret portable fire-extinguisher symbols.
- _____ 3. Analyze scenarios to determine appropriate safety and first-aid procedures.
- _____ 4. Interpret material safety data sheets.
- _____ 5. Analyze current reports concerning outdoor safety and first aid.
- _____ 6. Demonstrate the Heimlich maneuver for an adult choking victim.
- _____ 7. Lift a heavy object properly.
- _____ 8. _____
- _____ 9. _____
- _____ Written Test Score

Unit 2: Natural Resources and Conservation

- _____ 1. Report on a current event affecting natural resources.
- _____ 2. Report on a local natural resource problem.
- _____ 3. Identify recycling centers in your area.
- _____ 4. Trace route of recyclable products.
- _____ 5. Identify occupations in natural resources in your area.
- _____ 6. _____
- _____ 7. _____
- _____ Written Test Score

Competency Profile

Unit 3: Water Resource Management

- _____ 1. Evaluate your source of drinking water.
- _____ 2. Survey your area to identify water pollution sources.
- _____ 3. Determine ways to reduce home water consumption.
- _____ 4. Calculate the cost of water.
- _____ 5. Calculate and draw conclusions from water measurements.
- _____ 6. Analyze current reports concerning water resource management.

- _____ 7. _____
- _____ 8. _____
- _____ Written Test Score

Unit 4: Land Management

- _____ 1. Determine land capability classes.
- _____ 2. Determine fertilizer composition and rates.
- _____ 3. Read a soil test report.
- _____ 4. Report on GIS/GPS technology and utilization.
- _____ 5. Read a soil survey map.
- _____ 6. Read a conservation plan map.
- _____ 7. Complete a land use planning summary.
- _____ 8. Take a lawn and garden soil sample.
- _____ 9. _____
- _____ 10. _____

- _____ Written Test Score

Unit 5: Air Resource Management

- _____ 1. Locate sources of air pollution in your area.
- _____ 2. Write a report on an environmental problem related to air quality.
- _____ 3. Maintain a weather log for 10 days.
- _____ 4. Formulate weather forecasts.
- _____ 5. _____
- _____ 6. _____

- _____ Written Test Score

Unit 6: Energy Resources

- _____ 1. Discuss the effects of our dependence on imported oil.
- _____ 2. Compare electricity production from coal and nuclear fuel.
- _____ 3. Give your opinion on using agriculture products as alternative energy resources.
- _____ 4. Perform an energy audit of your home.
- _____ 5. Explore the various factions and viewpoints involved with the use of renewable and nonrenewable resources.
- _____ 6. _____
- _____ 7. _____

- _____ Written Test Score

Unit 7: Forestry

- _____ 1. Identify local trees.
- _____ 2. Determine the age of a tree.
- _____ 3. Determine uses of wood and wood by-products.
- _____ 4. Solve cord measurement problems.

- _____ 5. Analyze areas of conflict in maintaining forests and urban trees.
- _____ 6. Analyze current reports concerning areas of conflict in forestry.
- _____ 7. Plant a bareroot tree.
- _____ 8. Measure diameter of a tree.
- _____ 9. Measure merchantable height of a tree.

- _____ 10. _____
- _____ 11. _____
- _____ Written Test Score

Unit 8: Wildlife Management

- _____ 1. Explain effects on a food chain when parts are removed.
- _____ 2. Create a food web.
- _____ 3. Identify wildlife you see in a certain time span.
- _____ 4. Compile a profile of a wildlife species.
- _____ 5. Make management decisions concerning a deer herd.
- _____ 6. Analyze current reports concerning wildlife management.

- _____ 7. _____
- _____ 8. _____
- _____ Written Test Score

Unit 9: Wildlife Habitats

- _____ 1. Lay out and identify ways to improve a local habitat.
- _____ 2. Develop a management plan for a farm pond for sport fishing.
- _____ 3. Identify ways to improve a wetland habitat.
- _____ 4. Determine the carrying capacity of a rangeland habitat.
- _____ 5. Survey wildlife foods.
- _____ 6. Survey non-game birds at a feeding station.
- _____ 7. Increase hummingbird habitat.
- _____ 8. _____
- _____ 9. _____

- _____ Written Test Score

Unit 10: Outdoor Recreation

- _____ 1. Interpret graphs on future trends in outdoor recreation.
- _____ 2. Identify outdoor recreation activities and facilities available locally.
- _____ 3. Evaluate a local outdoor recreation site.
- _____ 4. Make a presentation about an outdoor recreation activity.
- _____ 5. Plan and design a new outdoor recreation area.
- _____ 6. Give accurate, easy-to-follow directions.
- _____ 7. Evaluate conflict resolution scenarios.
- _____ 8. Explore career opportunities in natural resources.
- _____ 9. _____
- _____ 10. _____

- _____ Written Test Score

Introduction to Natural Resources

Natural Resources Duty/Task Crosswalk

The following crosswalk aligns tasks covered in this product with the Oklahoma Natural Resources Duty/Task List. Duties A through H, Duties I, J, K, and L, which address workplace skills, are not part of the crosswalk, but have been included as a tool for instructors to assist them in preparing students for employment.

Using the crosswalk. The first column of the crosswalk identifies the occupation and emphasis area in which the tasks are performed (Refer to key below for letter designation). The second column identifies tasks/standards identified by industry representatives. The third column identifies the exact location by unit number and objective, student supplement, assignment sheet, and/or job sheet in *Introduction to Natural Resources*.

Occupations	Key
• Natural Resources Specialist: Range and Soils Emphasis	R
• Natural Resources Specialist: Environmental Quality Emphasis	E
• Natural Resources Specialist: Wildlife Emphasis	W
• Natural Resources Specialist: Parks and Recreation Emphasis	P

DUTY A: Demonstrate Knowledge of Natural Resources and Conservation

Occupations	Task	MAVCC Tasks
R, E, W, P	A.01 State importance of natural resources and conservation	Unit 2, Introduction and Objectives 4 and 5 Unit 3, Objective 2 Unit 4, Introduction and Objective 3 Unit 5, Introduction Unit 6, Introduction Unit 7, Introduction and Objective 2 Unit 8, Introduction Unit 9, Introduction Unit 10, Introduction
R, E, W, P	A.02 Describe the interaction of people with the environment —conflicts —report events affecting natural resources	Unit 2, Objectives 6 and 7; Assignment Sheet 1—Report on a Current Event Affecting Natural Resources; and Assignment Sheet 2—Report on a Local Natural Resource Problem Unit 7, Assignment Sheet 5—Analyze Areas of Conflict in Maintaining Forests and Urban Trees, and Assignment Sheet 6—Analyze Current Reports Concerning Areas of Conflict in Forestry Unit 10, Introduction and Objectives 4, 5, 6 and 7

Duty/Task Crosswalk

Occupations	Task	MAVCC Tasks
R, E, W, P	A.03 List types of natural resources —renewable —nonrenewable	Unit 2, Objective 2 Unit 6, Objective 3
R, E, W, P	A.04 Discuss components of a given environment —biological —physical	Unit 2, Objective 3 Water, Air, Land, Energy and Wildlife are covered in Units 3-9
R, E, W, P	A.05 Distinguish between preservation and conservation activities	Unit 2, Objectives 8, 9, and 10
R, E, W, P	A.06 Generate examples of preservation and conservation activities	Unit 2, Objective 10 and Objectives 11 through 15; Student Supplement 1—The Hows and Whys of Compost; Assignment Sheet 3—Identify Recycling Centers in Your Area; and Assignment Sheet 4—Trace Route of Recyclable Products Unit 6, Assignment Sheet 4—Perform an Energy Audit of Your Home Unit 7, Objective 15; Job Sheet 1—Plant a Bareroot Tree Unit 9, Assignment Sheet 1—Lay Out and Identify Ways to Improve a Local Habitat; Assignment Sheet 2—Develop a Management Plan for a Farm Pond for Sport Fishing; Assignment Sheet 4—Determine the Carrying Capacity of a Rangeland Habitat
R, E, W, P	A.07 Identify governmental agencies responsible for natural resources —local —state —federal	Unit 2, Objective 16 Unit 3, Objective 12 Unit 4, Objective 36 Unit 5, Objectives 3 and 10 Unit 7, Objective 13 Unit 8, Objective 23 Unit 10, Objective 8

Duty/Task Crosswalk

DUTY B: Demonstrate Knowledge of Water Resource Management

Occupations	Task	MAVCC Tasks
R, E, W, P	B.01 State importance of water resource management	Unit 3, Introduction and Objectives 2 and 3; Assignment Sheet 6—Analyze Current Reports Concerning Water Resource Management
R, E, W, P	B.02 Identify water uses	Unit 3, Objective 4; Student Supplement 1—Water Facts; and Student Supplement 2—Water Conservation Methods for Household Activities
R	B.03 Explain methods of protecting water sources	Unit 3, Assignment Sheet 3—Determine Ways to Reduce Home Water Consumption
R, E, W, P	B.04 Describe hydrologic cycle —distribution —surface water —ground water	Unit 3, Objectives 5, 6, 7 and 8
R, E	B.05 Identify water pollution sources	Unit 3, Objectives 9 and 11; Assignment Sheet 2—Survey Your Area to Identify Water Pollution Sources
R, E, W, P	B.06 Explain the effect of water pollution on the ecosystem	Unit 3, Objective 10; Assignment Sheet 6—Analyze Current Reports Concerning Water Resource Management
R, E, W, P	B.07 Discuss legislation of environmental protection of water resources	Unit 3, Objective 12
R, E, W, P	B.08 Identify types of watersheds	Unit 3, Objective 13
R, E, W, P	B.09 Understand water samples	
E, P	B.10 Describe and evaluate drinking water sources	Unit 3, Assignment Sheet 1—Evaluate Your Source of Drinking Water
E, P	B.11 Explain how drinking water is stored and distributed	Unit 3, Assignment Sheet 1—Evaluate Your Source of Drinking Water
R, E, W, P	B.12 Identify and distinguish among various types of wetlands	Unit 9, Objective 11
R, E, W, P	B.13 Explain the benefits and function of wetlands	Unit 9, Objective 11; Assignment Sheet 3—Identify Ways to Improve a Wetland Habitat
R, E, W, P	B.14 Describe human impact on wetlands	Unit 3, Objective 10
R, E, W, P	B.15 Discuss legislation regarding wetlands	Unit 3, Objective 12

Duty/Task Crosswalk

Occupations	Task	MAVCC Tasks
E, P	B.16 Identify kinds and sources of wastewater	Unit 3, Objective 9
E, P	B.17 Describe hazards in wastewater	Unit 3, Objective 11, and Student Supplement 3—Maximum Contaminant Levels and Lifetime Health Advisories
E, P	B.18 Describe ways of treating wastewater —bio-solids —biological and biochemical processes	
R, E, W	B.19 Identify point and non-point source pollution	Unit 3, Objective 9

DUTY C: Demonstrate Knowledge of Land Management

Occupations	Task	MAVCC Tasks
R, P	C.01 State the importance of land management	Unit 4, Introduction and Objective 3
R, P	C.02 Identify soil uses	Unit 4, Objectives 2 and 3
R, P	C.03 Describe soil formation process	Unit 4, Objectives 4 and 11
R, P	C.04 Identify major soil texture classes	Unit 4 Objective 12
R, P	C.05 Explain soil composition and functions of organic matter	Unit 4, Objectives 8 and 9
R, P	C.06 List horizons of soil profile —topsoil —subsoil —parent soil	Unit 4, Objective 11
R, P	C.07 Categorize soil into land capability classes	Unit 4, Objectives 12, 13, 14, and 23; Assignment Sheet 1—Determine Land Capability Classes
R, E	C.08 Interpret a soil survey map	Unit 4, Objective 32; Assignment Sheet 5—Read a Soil Survey Map
R, E, W, P	C.09 Take soil samples	Unit 4, Objective 24; Assignment Sheet 3—Read a Soil Test Report; Job Sheet 1—Take a Lawn and Garden Soil Sample
R	C.10 Identify types, causes, and effects of erosion	Unit 4, Objectives 15, 16, 17 and 18
R, E, P	C.11 Identify methods to control erosion in rural and urban areas	Unit 4, Objectives 27, 28, and 29
R, E, W, P	C.12 Discuss current Farm Bill programs	Unit 4, Objectives 35 and 36
P	C.13 Define SCORP (Statewide Comprehensive Recreation Plan)	

Duty/Task Crosswalk

Occupations	Task	MAVCC Tasks
R	C.14 Outline steps in the land use planning process	Unit 4, Objective 34; Assignment Sheet 7—Complete a Land Use Planning Summary
R, E, W, P	C.15 Obtain distances using measuring devices	
R, E, W, P	C.16 Use appropriate equipment to conduct a basic land survey	
R, E, W, P	C.17 Differentiate between public and private land	Unit 4, Objective 29

DUTY D: Demonstrate Knowledge of Air Resource Management

Occupations	Task	MAVCC Tasks
E	D.01 State importance of air resource management	Unit 5, Introduction and Objectives 3 and 13
E	D.02 Discuss composition of percentages of air pollution	Unit 5, Objective 2
E	D.03 Locate air pollutants and their health hazards	Unit 5, Objectives 4, 6 and 7; Assignment Sheet 1—Locate Sources of Air Pollution in Your Area
R, E	D.04 Locate sources of air pollution —industry —electrical motor —motor emissions	Unit 5, Objectives 4, 5, 11 and 12; Assignment Sheet 2—Write a Report on an Environmental Problem Related to Air Quality
E	D.05 List environmental effects of air pollution —greenhouse effect —acid rain —ozone shield —smog	Unit 5, Objective 5; Assignment Sheet 2—Write a Report on an Environmental Problems Related to Air Quality
E, P	D.06 Discuss air quality regulations	Unit 5, Objectives 3, 8, 10; Student Supplement 1—Allowance Trading System
E, P	D.07 Describe seasonal effects on air quality	Unit 5, Introduction and Objectives 5 and 14; Student Supplement 2—Understanding the Weather
E	D.08 Describe the impact of air pollution on humans and other living organisms	Unit 5, Objectives 6 and 7
E	D.09 Identify elements of an air quality analysis	
R, E	D.10 Examine wind (air) as an alternative energy resource	Unit 6, Introduction and Objectives 3 and 11

Duty/Task Crosswalk

DUTY E: Understand Ecosystems

Occupations	Task	MAVCC Tasks
R, E, W, P	E.01 Define ecosystem	Unit 8, Introduction
R, E, W, P	E.02 Explain types of ecosystems	Unit 8, Introduction
R, E, W, P	E.03 Understand the importance of ecosystems	Unit 3, Objective 10; Assignment Sheet 6—Analyze Current Reports Concerning Water Resource Management Unit 8, Introduction and Objectives 2, 3, and 4; Assignment Sheet 1—Explain Effects on a Food Chain When Parts are Removed; Assignment Sheet 2—Create a Food Web
R, E, W, P	E.04 Explain ecosystem management	See above.
R, E, W, P	E.05 Explain the human impact on ecosystems —agriculture —forestry —recreation	Unit 7, Introduction and Objective 2 Unit 9, Objectives 7, 9, 10, 11, 12, 13, 14, and 15 Unit 10, introduction

DUTY F: Understand Basic Principles Associated with Plant Science

Occupations	Task	MAVCC Tasks
R, W, P	F.01 Describe approved practices in food plot management	
R, W, P	F.02 Identify and recognize plant species —invasive —exotic	Unit 7, Objective 10, Assignment Sheet 1—Identify Local Trees
R, W, P	F.03 Demonstrate the ability to use resource information to identify plants	Unit 7, Assignment Sheet 1—Identify Local Trees

DUTY G: Explain Principles Associated with Waste Management

Occupations	Task	MAVCC Tasks
R, E, W, P	G.01 Describe kinds and sources of waste —solid —hazardous —liquid —bio	Unit 2, Objectives 11 and 12 Unit 3, Objectives, 9, 10, 11
R, E, W, P	G.02 Interpret MSDS sheets	Unit 1, Objective 11, and Student Supplement 6—Guidelines for Interpreting Material Safety Data Sheets; Assignment Sheet 4—Interpret Material Safety Data Sheets

Duty/Task Crosswalk

Occupations	Task	MAVCC Tasks
R, E, W, P	G.03 Identify agencies responsible for waste management	Unit 2, Objective 16 Unit 3, Objective 12
R, E, W, P	G.04 Identify methods of waste reduction activities	Unit 2, Objective 14
R, E, W, P	G.05 State advantages and disadvantages of various methods of waste disposal	Unit 2, Objectives 13, 14 and 15
R, E, W, P	G.06 Explain potential hazards in solid waste materials and disposal	Unit 2, Assignment Sheet 2—Report on a Local Natural Resource Problem
R, E, W, P	G.07 Explain the importance of recycling	Unit 2, Objectives 14 and 15
R, E, P	G.08 Develop a recycling plan	Unit 2, Assignment Sheet 3—Identify Recycling Centers In Your Area; and Assignment Sheet 4—Trace Route of Recyclable Products
R, E, P	G.09 Describe composting —methods —benefits	Unit 2, Student Supplement 1—The Hows and Whys of Compost

DUTY H: Understand Concepts Associated with Wildlife

Occupations	Task	MAVCC Tasks
R, E, W, P	H.01 Define and describe habitat and wildlife management	Unit 8, Introduction Unit 9, Introduction and Objectives 2 and 3
R, W, P	H.02 Discuss wildlife laws	Unit 8, Objective 6
R, W, P	H.03 Discuss ethics associated with wildlife	Unit 8, Objective 5
R, W, P	H.04 Identify agricultural management practices for improvement of habitat	Unit 8, Objectives 18, 21 and 22 Unit 9, Objectives 4, 5, 6
R, W, P	H.05 Identify rural and urban assistance available for habitat improvement	Unit 9, Assignment Sheet 1—Lay Out and Identify Ways to Improve a Local Habitat
R, W, P	H.06 Explain concepts of wildlife management —carrying capacity —inter relationships —territoriality —succession stages —migration —life cycles	Unit 8, Introduction and Objectives 3, 4, 16 Unit 9, Objective 4; Assignment Sheet 4—Determine the Carrying Capacity of a Rangeland Habitat
R, W, P	H.07 Design a wildlife management plan	Unit 8, Assignment Sheet 5—Make Management Decisions Concerning a Deer Herd Unit 9, Assignment Sheet 2—Develop a Management Plan for a Farm Pond for Sport Fishing

Duty/Task Crosswalk

Occupations	Task	MAVCC Tasks
R, W, P	H.08 Evaluate and define wildlife habitat —components	Unit 8, Assignment Sheet 4— Compile a Profile of a Wildlife Species Unit 9, Assignment Sheet 1—Lay Out and Identify Ways to Improve a Local Habitat; and Job Sheet 1— Increase Hummingbird Habitat
R, W, P	H.09 Identify wildlife resources —economic benefits —social value —aesthetic value —scientific and educational value	
R, W, P	H.10 Estimate wildlife populations on given areas of land	Unit 8, Assignment Sheet 5—Make Management Decisions Concerning a Deer Herd Unit 9, Assignment Sheet 4— Determine the Carrying Capacity of a Rangeland Habitat
R, E, W, P	H.11 Discuss common relationships between humans and wildlife —positive —negative	Unit 8, Objectives 18, 19, 20, 21, 22 Unit 9, Objectives 6 and 7
R, E, W, P	H.12 Identify introduced wildlife species and their impacts	Unit 8, Objectives 7, 8, 9, 10, 11, 12, 13, 14 and 15; Assignment Sheet 3—Identify Wildlife You See in a Certain Time Span Unit 9, Assignment Sheet 6— Survey Non-Game Birds at a Feeding Station
R, E, W, P	H.13 Identify current issues in wildlife diseases	Unit 8, Assignment Sheet 6— Analyze Current Reports Concerning Wildlife Management
R, W, P	H.14 Investigate methods to control nuisance wildlife	

Duty/Task Crosswalk

Note: The following duty areas address workplace skills that may be reinforced in the classroom as students complete assignment sheets and job sheets and assume responsibilities delegated by their instructor. Customize these lists by indicating how skills are addressed/reinforced through instructional strategies, classroom activities, and student assessment.

DUTY I: Exhibit Personal Social Skills for the Workplace

Occupations	Task	How Reinforced in Class
R, E, W, P	I.01 Use good work habits such as punctuality, orderliness, and patience	
R, E, W, P	I.02 Effectively plan and schedule work tasks and assignments	
R, E, W, P	I.03 Maintain appearance and health	
R, E, W, P	I.04 Participate in applicable training opportunities	
R, E, W, P	I.05 Use appropriate ethical behavior such as integrity and honesty	
R, E, W, P	I.06 Adjust and adapt to new and unique ideas and situations	
R, E, W, P	I.07 Assume responsibility for individual actions and/or department and company operations	
R, E, W, P	I.08 Maintain a positive attitude toward individual responsibilities and/or department and company operations	
R, E, W, P	I.09 Accept constructive criticism and take appropriate corrective actions	
R, E, W, P	I.10 Maintain necessary endurance, forbearance, and persistence in order to accomplish goals and objectives	
R, E, W, P	I.11 Display appropriate sense of humor	
R, E, W, P	I.12 Budget time effectively	
R, E, W, P	I.13 Use success or failure constructively in a work situation	

DUTY J: Use Communication and Research Skills

Occupations	Task	How Reinforced in Class
R, E, W, P	J.01 Use legible handwriting in preparing forms, messages, and reports	
R, E, W, P	J.02 Listen attentively to directions, assignments, and information from customers, supervisors, or managers	

Duty/Task Crosswalk

Occupations	Task	How Reinforced in Class
R, E, W, P	J.03 Communicate verbally with clientele, employees, supervisors, suppliers, etc.	
R, E, W, P	J.04 Understand reports, forms policies, and product information	
R, E, W, P	J.05 Complete correspondence, reports, forms, and notes	
R, E, W, P	J.06 Interpret work schedules	
R, E, W, P	J.07 Manage information from tables, graphs, charts, such as tax tables, work schedules, organizational charts, etc.	
R, E, W, P	J.08 Use the telephone correctly	
R, E, W, P	J.09 Use and interpret computer output such as printouts, visual display screens, etc.	

DUTY K: Use Interpersonal Skills in Working with Others

Occupations	Task	How Reinforced in Class
R, E, W, P	K.01 Exhibit cooperative work habits with other employees, supervisors, and managers	
R, E, W, P	K.02 Exhibit courtesy toward clientele, suppliers, and others	
R, E, W, P	K.03 Use appropriate assertiveness with others in the workplace	
R, E, W, P	K.04 Exhibit sensitivity to the needs of individuals	
R, E, W, P	K.05 Assume shared responsibility for the success or failure for the workgroup	
R, E, W, P	K.06 Maintain creditability with customers, co-workers, employees, and managers	
R, E, W, P	K.07 Adjust to the demands of the job requirements such as deadlines, pressures, conflicts, etc.	
R, E, W, P	K.08 Recognize different client types and meet the special needs of each type, including: individuals, groups, associations, educational groups, corporations, leisure tour groups, etc.	
R, E, W, P	K.09 Manage difficult clientele	

Duty/Task Crosswalk

DUTY L: Apply Management Principles

Occupations	Task	How Reinforced in Class
R, E, W, P	L.01 Discuss industry related trends and developments	
R, E, W, P	L.02 Understand the concept of budgets	

Introduction to Natural Resources

Instructional/Task Analysis

**Related Information: What
the Student Should Know**

**Application: What the
Student Should Be Able to Do**

Unit 1: Outdoor Safety and First Aid

- | | |
|---|--|
| 1. Terms and definitions | 12. Guidelines for lifting and carrying items safely |
| 2. Basic first-aid procedures for emergency situations | 13. Read wind chill index and water survival charts |
| 3. Contents of a first-aid kit | 14. Interpret portable fire-extinguisher symbols |
| 4. Types of poisonous snakes | 15. Analyze scenarios to determine appropriate safety and first-aid procedures |
| 5. Types of poisonous plants | 16. Interpret material safety data sheets |
| 6. Types of poisonous spiders | 17. Analyze current reports concerning outdoor safety and first aid |
| 7. Safety precautions to take in inclement weather | 18. Demonstrate the Heimlich maneuver for an adult choking victim |
| 8. Components of the fire triangle | 19. Lift a heavy object properly |
| 9. Classes of fires and their definitions | |
| 10. Types of fire extinguishers and classes of fires they were designed to extinguish | |
| 11. Purposes of a material safety data sheet | |

Unit 2: Natural Resources and Conservation

1. Terms and definitions
2. Difference between renewable and nonrenewable natural resources
3. Basic components of the physical environment
4. History of natural resources
5. Importance of natural resources
6. Conflicts in natural resources management
7. Factors which affect natural resources
8. Preservation and conservation of natural resources
9. Preservation activities
10. Conservation activities

Instructional/Task Analysis

Related Information: What the Student Should Know

Application: What the Student Should Be Able to Do

Unit 2: Natural Resources and Conservation (cont.)

- | | |
|--|--|
| 11. Categories of solid waste | 20. Report on a current event affecting natural resources |
| 12. Composition of solid waste in a typical municipal landfill | 21. Report on a local natural resource problem |
| 13. Methods of waste disposal | 22. Identify recycling centers in your area |
| 14. Waste reduction activities | 23. Trace route of recyclable products |
| 15. Recyclables and nonrecyclables | 24. Identify occupations in natural resources in your area |
| 16. Federal agencies responsible for natural resources | |
| 17. Types of occupations in natural resources | |
| 18. Ways of getting a job in natural resources | |
| 19. Characteristics of a person working in natural resources | |

Unit 3: Water Resource Management

- | | |
|---|--|
| 1. Terms and definitions | 16. Evaluate your source of drinking water |
| 2. History of importance of water in the United States | 17. Survey your area to identify water pollution sources |
| 3. Water distribution | 18. Determine ways to reduce home water consumption |
| 4. Uses of water | 19. Calculate the cost of water |
| 5. Hydrologic (water) cycle | 20. Calculate and draw conclusions from water measurements |
| 6. Surface water | 21. Analyze current reports concerning water resource management |
| 7. Ground water | |
| 8. Relationship between ground water and surface water | |
| 9. Water pollution | |
| 10. Comparison of the environment—1960 and now | |
| 11. Hazardous/toxic waste | |
| 12. Federal legislation for environmental protection of water resources | |
| 13. Watersheds | |
| 14. Water measurements | |
| 15. Career opportunities in water resource management | |

Instructional/Task Analysis

**Related Information: What
the Student Should Know**

**Application: What the
Student Should Be Able to Do**

Unit 4: Land Management

1. Terms and definitions
2. Agricultural and non-agricultural land uses
3. Reasons soil is important
4. How soils are formed
5. Types of rocks
6. Weathering factors
7. Types of soils and ways they are deposited
8. Composition of an average soil
9. Functions of organic matter
10. Major factors that affect land capability classes
11. Horizons of a soil profile
12. Categories of soil texture
13. Categories of soil depth
14. Classes of slope
15. Types of erosion
16. Causes of erosion
17. Effects of erosion
18. Contributors of erosion pollution
19. Classes of erosion
20. Types of soil structure
21. Levels of permeability
22. Classes of surface runoff
23. Land capability classes
24. Soil testing
25. Major and minor plant nutrients
26. Nutrients in a fertilizer analysis
27. Methods of controlling erosion on the farm
28. Methods of controlling non-farm erosion
29. Rangeland management
30. Reclamation of mined lands

Instructional/Task Analysis

Related Information: What the Student Should Know

Application: What the Student Should Be Able to Do

Unit 4: Land Management (cont.)

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|--|--|
| 31. Global Positioning System and Geographic Information systems (GPS) | 38. Determine land capability classes |
| 32. Soil survey reports | 39. Determine fertilizer composition and rates |
| 33. Parts of a conservation plan | 40. Read a soil test report |
| 34. Parts of a land use planning summary | 41. Report on GIS/GPS technology and utilization |
| 35. Stewards of the soil | 42. Read a soil survey map |
| 36. USDA and DOI roles in land management practices | 43. Read a conservation plan map |
| 37. Career opportunities in land management | 44. Complete a land use planning summary |
| | 45. Take a lawn and garden soil sample |

Unit 5: Air Resource Management

- | | |
|---|---|
| 1. Terms and definitions | 16. Locate sources of air pollution in your area |
| 2. Composition and percentages of air components (unpolluted) | 17. Write a report on an environmental problem related to air quality |
| 3. Importance of air quality | 18. Maintain a weather log for 10 days |
| 4. Air pollutants and their characteristics and health hazards | 19. Formulate weather forecasts |
| 5. Environmental effects of air pollution | |
| 6. Indoor air pollution | |
| 7. Indoor air pollutants and their characteristics | |
| 8. Clean Air Act Amendments of 1990 | |
| 9. Methods of controlling motor vehicle emissions | |
| 10. Types of pollution control measures that the government may impose on polluters | |
| 11. Methods of controlling pollution from industry and electrical power generating plants | |
| 12. Air quality trends in the United States | |
| 13. Global considerations in air resource management | |
| 14. Factors that cause weather | |
| 15. Career opportunities in air resource management | |

Instructional/Task Analysis

Related Information: What the Student Should Know

Application: What the Student Should Be Able to Do

Unit 6: Energy Resources

- | | |
|--|--|
| 1. Terms and definitions | 18. Discuss the effects of our dependence on imported oil |
| 2. Terms used to describe energy conversion | |
| 3. Classifications of energy resources | 19. Compare electricity production from coal and nuclear fuel |
| 4. Coal energy resources | |
| 5. Oil energy resources | 20. Give your opinion on using agricultural products as alternative energy resources |
| 6. Natural gas energy resources | |
| 7. Nuclear energy resources | 21. Perform an energy audit of your home |
| 8. Hydropower energy resources | |
| 9. Biomass energy resources | 22. Explore the various factions and viewpoints involved in the use of renewable and nonrenewable resources. |
| 10. Solar energy resources | |
| 11. Wind energy resources | |
| 12. Geothermal energy resources | |
| 13. U.S. energy reserves | |
| 14. Uses of oil resources in the U.S. | |
| 15. Goals of energy conservation | |
| 16. Ways to conserve energy | |
| 17. Career opportunities related to energy resources | |

Unit 7: Forestry

1. Terms and definitions
2. Forestry
3. Main parts of a tree
4. Parts of the crown
5. Parts of the trunk
6. Types of roots and their functions
7. Ways trees are identified
8. Photosynthesis
9. Growth of a tree
10. Classifications of trees
11. Common uses of trees
12. Benefits of forests to the environment

Instructional/Task Analysis

**Related Information: What
the Student Should Know**

**Application: What the
Student Should Be Able to Do**

Unit 7: Forestry (cont.)

- | | |
|---|--|
| 13. Government forestry agencies | 25. Identify local trees |
| 14. Major forest regions of the United States | 26. Determine the age of a tree |
| 15. Types of forest cuttings | 27. Determine uses of wood and wood by-products |
| 16. Ways that tree stands regenerate | 28. Solve cord measurement problems |
| 17. Forest measurements | 29. Analyze areas of conflict in maintaining forests and urban trees |
| 18. Measuring instruments used in forestry | 30. Analyze current reports concerning areas of conflict in forestry |
| 19. Forest enemies | 31. Plant a bareroot tree |
| 20. Causes of fire | 32. Measure diameter of a tree |
| 21. Types of forest fires | 33. Measure merchantable height of a tree |
| 22. Categories of forest fires | |
| 23. Benefits of controlled burns | |
| 24. Career opportunities related to forestry | |

Unit 8: Wildlife Management

1. Terms and definitions
2. Food chain
3. Interconnections in a food web
4. Predator/prey relationship
5. History of wildlife in the United States
6. Federal legislation concerning wildlife
7. Vertebrate and invertebrate wildlife
8. Characteristics of a mammal
9. Small mammals and large mammals
10. Characteristics of fish wildlife
11. Characteristics of birds
12. Major types of birds
13. Characteristics of reptiles
14. Characteristics of amphibians
15. Types of invertebrate wildlife
16. Classifications of wildlife that need protection
17. Dangers to wildlife populations
18. Agricultural practices that support wildlife

Instructional/Task Analysis

Related Information: What the Student Should Know

Application: What the Student Should Be Able to Do

Unit 8: Wildlife Management (cont.)

- | | |
|--|--|
| 19. Wildlife activities that may cause damage to agriculture | 25. Explain effects on a food chain when parts are removed |
| 20. Ways to control wildlife damage problems | 26. Create a food web |
| 21. Public wildlife and private lands | 27. Identify wildlife you see in a certain time span |
| 22. Types of private wildlife production areas | 28. Compile a profile of a wildlife species |
| 23. Government agencies involved in wildlife management | 29. Make management decisions concerning a deer herd |
| 24. Career opportunities related to wildlife management | 30. Analyze current reports concerning wildlife management |

Unit 9: Wildlife Habitats

- | | |
|---|---|
| 1. Terms and definitions | 16. Lay out and identify ways to improve a local habitat |
| 2. Components of a habitat | 17. Develop a management plan for a farm pond for sport fishing |
| 3. Objectives of wildlife habitat management | 18. Identify ways to improve a wetland habitat |
| 4. Habitat management principles | 19. Determine the carrying capacity of a rangeland habitat |
| 5. Common tools and techniques of habitat improvement | 20. Survey wildlife foods |
| 6. Actions taken to improve wildlife habitats | 21. Survey non-game birds at a feeding station |
| 7. Causes of habitat destruction | 22. Increase hummingbird habitat |
| 8. Types of wildlife habitats | |
| 9. Lakes, ponds, and pothole habitats | |
| 10. River and stream habitats | |
| 11. Wetland habitats | |
| 12. Woodland habitats | |
| 13. Rangeland habitats | |
| 14. Farmland habitats | |
| 15. Urban habitats | |

Instructional/Task Analysis

**Related Information: What
the Student Should Know**

**Application: What the
Student Should Be Able to Do**

Unit 10: Outdoor Recreation

- | | |
|--|--|
| 1. Terms and definitions | 11. Interpret graphs on future trends in outdoor recreation |
| 2. Equipment and facilities needed for outdoor recreation activities | 12. Identify outdoor recreation activities and facilities available locally. |
| 3. Skills and licenses needed for outdoor recreation activities | 13. Evaluate a local outdoor recreation site |
| 4. Major factors increasing the demand and participation in outdoor recreation | 14. Make a presentation about an outdoor recreation activity |
| 5. Other factors affecting current and future participation in recreational activities | 15. Plan and design a new outdoor recreation area |
| 6. Considerations when selecting an outdoor recreation area | 16. Give accurate, easy-to-follow directions |
| 7. Reasons why people participate in outdoor recreation | 17. Evaluate conflict resolution scenarios |
| 8. Agencies responsible for public lands, recreation areas, and employment in outdoor recreation | 18. Explore career opportunities in natural resources |
| 9. Employment opportunities in outdoor recreation | |
| 10. Business opportunities in outdoor recreation | |

Introduction to Natural Resources

Basic Skills Icons and Classifications

To assist teachers and students in identifying and documenting where academic and workplace skills are being taught, MAVCC has adopted a system that uses icons and a list of specific tasks to identify the skill or skills that are used in each assignment sheet and job sheet.

A matrix for each of the ten broad skill areas has been included in this edition and reflects key elements from *What Work Requires of Schools: A SCANS Report for America 2000*, a 1991 study by the U.S. Department of Labor; *Workplace Basics: The Skills Employers Want*, a three-year study conducted jointly by the American Society for Training and Development (ASTD) and the United States Department of Labor (DOL); and other national and state sources.

Each of the ten broad skill areas—reading, writing, mathematics, science, oral communication, interpersonal or relating, critical thinking, employability, social studies, and technology—is represented by the icon presented below.



Reading Skills

- Reading Comprehension
- Research/Reference
- Functional Reading



Writing Skills

- Language
- Composition
- Research
- Functional Writing



Math Skills

- Operation and Calculation
- Math Application
- Data Analysis and Display
- Functional Math

Basic Skills Icons and Classifications



Science Skills

- General Science
- Life Science
- Physical Science
- Earth Science



Oral Communication Skills

- Oral Presentation
- Listening
- Interactive Communication



Interpersonal or Relating Skills

- General Relating
- Teamwork/Cooperation
- Leadership/Influence



Critical Thinking Skills

- Cognitive Activities



Employability Skills

- Job Search/Selections
- Job Acquisition/Development
- Resource Management
- Job Safety



Social Studies Skills

- Information Analysis
- Social Studies Application
- Functional Social Studies



Technology Skills

- Selection
- Application
- Maintenance/Troubleshooting

Basic Skills Icons and Classifications

Reading Skills	
Reading Comprehension	• Gain factual information • Distinguish fact, opinion, and inference • Recognize stereotyping and bias • Recognize propaganda • Analyze cause and effect • Draw conclusions • Make generalizations • React to written material • Apply word analysis techniques • Analyze and apply what has been read to specific task • Comprehend written information for main ideas • Determine what information is needed
Research/Reference	• Select useful resources • Locate resources • Find materials in library • Use standard references • Use in-book reference tools • Use audiovisual media • Use computer database • Use magazines and newspapers
Functional Reading	• Interpret forms and records • Follow written instructions • Interpret graphics and symbols • Interpret abbreviations/acronyms • Read aloud • Apply/understand technical words that pertain to subject

Basic Skills Icons and Classifications

	Writing Skills
Language	• Use standard grammar, spelling, and capitalization • State ideas clearly
Composition	• Use complete sentences • Develop preliminary outline • Use topic sentences • Use introductory/closing paragraphs • Compose reports • Compose essays • Proofread and edit • Construct graphics and symbols
Research	• Take notes • Use note cards • Create bibliography • Use footnotes • Outline material
Functional Writing	• Complete forms and records • Write instructions • Write letters • Write job applications • Write resumes • Use word processing • Use computer graphics • Use content area vocabulary

Basic Skills Icons and Classifications

	Math Skills
Operation and Calculation	• Round off numbers • Estimate answers • Use scientific notations • Use exponential notations • Calculate with whole numbers • Calculate with fractions • Calculate with decimals • Convert whole numbers to fractions • Convert whole numbers to decimals • Solve numerical expressions • Solve formulae and equations • Obtain squares and square roots • Convert units of measure • Perform metric calculations
Math Application	• Solve word problems • Select/apply mathematical formula • Select/apply mathematical procedure • Use English and metric measures • Solve time/rate/distance problems • Solve ratio/proportion problems • Solve percent problems • Apply techniques of scaling • Apply algebra principles • Apply geometry principles • Apply trigonometry principles
Data Analysis and Display	• Interpret charts and tables • Interpret graphs • Collect/record data • Apply sampling techniques • Apply principles of probability • Construct charts and tables • Construct graphs • Calculate statistics • Interpret statistics • Interpret plans/blueprints • Draw facility to scale

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Basic Skills Icons and Classifications

Functional Math

Math Skills (Continued)

- Make measurements
- Perform banking transactions
- Make change
- Solve practical problems
- Calculate gross earnings
- Solve income/expense problems
- Prepare a budget
- Calculate interest
- Solve interest problems
- Calculate sales tax
- Determine income tax
- Use calculator for computation
- Use computer for computation
- Use computer spreadsheets
- Apply computation skills as they are actually used on the job
- Calculate measurements taken from measuring devices
- Perform/prepare an inventory
- Calculate and compare shipping costs
- Prepare financial report

Basic Skills Icons and Classifications

	Science Skills
General Science	• Apply computing skills • Apply scientific method of inquiry • Conduct experiments • Investigate science ethics • Investigate science history • Investigate/apply economics in technology • Use scientific instruments • Investigate/apply technology • Collect specimens • Construct model to depict basic concept of ----
Life Science	• Identify/classify living organisms • Investigate biological history of the earth • Investigate food chains, webs, pyramids • Investigate/apply principles of human development • Investigate/apply principles of genetics/heredity • Investigate/apply principles of anatomy/physiology • Investigate health issues • Observe health code/sanitation requirements
Physical Science	• Analyze/classify matter • Investigate forms/changes of matter • Investigate forms/changes of energy • Investigate/apply chemical properties • Investigate/apply physical laws
Earth Science	• Investigate physical characteristics of the earth • Investigate geological history of the earth • Investigate physical forces acting on the earth • Solve problems of longitude, latitude, and time zones • Investigate conservation of physical resources • Investigate conservation of living resources • Investigate issues of environmental impact • Apply science principles to environmental issues

Basic Skills Icons and Classifications

	Oral Communication Skills
Oral Presentation	• Make informative presentations • Make persuasive presentations • Present personal opinion/viewpoint • Use good speaking techniques • Select/use words effectively • Use effective body language • Present appropriate appearance • Integrate audio and/or visual materials into oral presentations • Adapt presentation to specific audience
Listening	• Apply active listening skills • Distinguish fact, opinion, and inference • Draw conclusions/make generalizations • Analyze/identify point of view
Interactive Communication	• Give/follow oral directions • Apply questioning techniques • Conduct/receive interviews • Analyze/apply nonverbal communication • Work effectively in a group • Communicate with clients/customers/patients • Communicate with coworkers • Communicate with supervisors • Communicate with professional colleagues/associates • Apply telephone etiquette

Basic Skills Icons and Classifications

Interpersonal or Relating Skills

General Relating

- Investigate/apply communication process models
- Analyze/apply nonverbal communication
- Investigate/apply cross-cultural communication
- Interact with coworkers
- Interact with supervisors
- Interact with clients/customers/patients
- Interact with professional colleagues/associates
- Interact with family/friends
- Participate in group activities
- Participate in industrial relations/functions
- Identify personal values/attitudes
- Apply information to life experiences

Teamwork/ Cooperation

- Identify values/attitudes
- Identify needs/drives
- Select/apply appropriate behavior
- Investigate/identify personal styles
- Investigate/identify group/corporate climate
- Give/receive feedback
- Identify hidden purposes
- Investigate/apply group dynamics
- Control undesirable/inappropriate behavior
- Resolve conflicts
- Clarify goals/objectives
- Devise "win/win" situations
- Build consensus
- Generate ideas
- Present point of view

Leadership/ Influence

- Analyze/apply leadership styles
- Analyze/apply management styles
- Obtain confidence of others
- Develop esteem in self/others
- Persuade others
- Analyze/apply motivation techniques
- Provide positive coaching

Basic Skills Icons and Classifications

Cognitive Activities

Critical Thinking Skills

- Collect/record information
- Identify critical elements/issues
- Define a problem
- Identify underlying causes
- Apply a problem-solving model
- Analyze/synthesize information
- Identify/analyze underlying assumptions
- Draw conclusions
- Predict results/outcomes
- Identify/evaluate consequences
- Identify/develop alternatives
- Evaluate alternatives
- Select an alternative
- Devise a solution
- Create a finished product
- Apply intuitive thinking techniques
- Transfer knowledge/training to new situations
- Apply new technology
- Develop an action plan
- Evaluate results/outcomes
- See relationship between two or more ideas, objects, or situations

Basic Skills Icons and Classifications

Employability Skills

Job Search/ Selections

- Analyze personal occupational aptitudes/preferences
- Investigate employment prospects of a career field/occupation
- Investigate training requirements for a career field/occupation
- Investigate benefits of a career field/occupation
- Compare/evaluate career options
- Analyze impact of work on individual and family life

Job Acquisition/ Development

- Develop personal career path
- Locate appropriate jobs
- Analyze duties/requirements/benefits of specific job
- Master specific job task/procedure
- Complete job-related applications
- Write a letter of application
- Write personal resume
- Interview for a job
- Apply business etiquette
- Practice good work habits/attitudes
- Practice good personal presentation
- Develop self confidence/esteem
- Develop effective leadership
- Deal effectively with supervisors
- Deal effectively with coworkers
- Deal effectively with professional colleagues/associates
- Deal effectively with customers/clients/patients
- Follow established rules, regulations, and policies
- Promote the goals and values of the organization
- Exert a high level of effort and perseverance towards goal attainment
- Set high standards for self in completion of a task

Resource Management

- Complete task in timely manner
- Determine cost, time, and resources to complete a task
- Perform routine tasks related to equipment operation and/or maintenance

Job Safety

- Demonstrate safe use of tools, equipment, and supplies
- Observe safety rules
- Wear safety equipment
- Follow safety procedures
- Demonstrate proper use of safety device

Basic Skills Icons and Classifications

	Social Studies Skills
Information Analysis	• Collect/record data • Interpret graphical information • Construct graphical information • Interpret maps/globes • Interpret statistical information • Analyze/interpret demographic information • Distinguish trends and predicts impact of actions on systems operations
Social Studies Application	• Investigate/apply U.S. history • Investigate/apply world history • Investigate/apply U.S. geography • Investigate/apply world geography • Investigate/apply principles of government/politics • Investigate/apply principles of economics • Investigate/apply principles of ethics • Investigate/apply principles of sociology • Investigate/apply cross-cultural studies
Functional Social Studies	• Practice responsible personal economics • Prepare a personal budget • Use credit responsibly • Practice good work ethics • Participate in industrial relations • Interact with people of different races/cultures • Investigate/participate in government • Investigate/apply American legal practices • Select/use sources of information on current events • Analyze current events • Analyze consumer issues • Analyze social issues • Analyze conservation/ecology issues • Analyze social impact of science/technology • Analyze economic impact of science/technology • Understand how social, organizational, and technological systems work and operate effectively

Basic Skills Icons and Classifications

	Technology Skills
Selection	• Choose procedures, tools, or equipment including computers and related technologies that will produce the desired results
Application	• Demonstrate the proper procedures for setting up and operating equipment, including computers and their programming systems
Maintenance/ Troubleshooting	• Perform maintenance on equipment, including computers and other technologies • Identify and correct problems with equipment • Report damaged or broken equipment to appropriate individual

BASIC SKILLS MATRIX



				X	
X					
X	X	X	X	X	X
				X	
	X		X	X	X
X	X	X	X	X	X
X		X	X	X	X
X	X	X	X	X	X
X	X	X	X	X	X

Unit 6
Energy Resources

BASIC SKILLS MATRIX



Technology

X	X		X
X	X	X	X
X		X	
X		X	X
X	X	X	X
X	X	X	X
X	X	X	X
X	X	X	X

Unit 10
Outdoor Recreation

Introduction to Natural Resources

Tools, Equipment and Materials List

Bareroot tree
Binoculars
Bird feeders
Camera, flash attachment, film
Carpenter tape
CPR dummy
Diameter tape
Flower to flower seed
Garden hose
Garden tools
Gloves
Hummingbird feeder
Marking pens
Paper and pencil
Peat moss or other organic matter
Plant seeds or seedlings
Plastic bucket
Plastic sheeting
Portable fire extinguisher
Poster board, white (2)
Reference library (books, magazines, newspaper)
Safety equipment such as gloves, hard hats, eye and ear protection
Shovel
Soil samples
Soil sampling information kit
Soil sampling kit
Soil tube, soil auger
Star chart
Telephone book or business directory
Tool kit, basic
Tree scale stick (Biltmore)
Water
Wildlife brochures
Yardsticks (8-10)

Note: You may also need to arrange for county or state air monitoring, soil testing, and water analysis so students can complete corresponding assignment sheets.

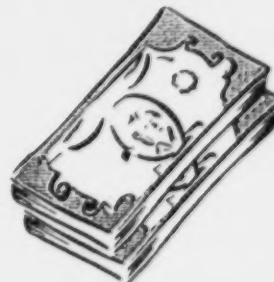
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Suggestions

- Product Needs (supplemental resources, additional publications, etc.)

- Other Ideas

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Unit 1**Outdoor Safety and First Aid**

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* Assignment Sheets and Job Sheets are located in the Student Workbook.

Instructional
Plan

Suggested Activities

Preparation

- Review the objective sheet. Study the specific objectives to determine the order in which you will present the objectives.
- Review the suggested lesson plan. The plan identifies an order for instruction to take place. Each "day" represents a 50-minute class period. The plan is designed to cover the specific objectives over a 15-day period. Additional days and/or activities may be added. (Note: You may want to change days to specific dates. Example: Day 1 may become Monday, August 21, Day 2 = Tuesday, August 22, and so forth.) You will want to localize, supplement, and personalize the plan to fit your situation.
- Review the teaching suggestions included in this instructional plan section to plan classroom activities. Also note the suggestions for suggested supplemental resources.
- Plan your delivery/application to take advantage of student learning styles and to accommodate special-needs students.
- Obtain films, videotapes, and other resources to supplement instruction of this unit. See "Resources Used in Developing This Unit" and "Suggested Supplemental Resources" for more information.
- Make transparencies or computer presentation from the transparency masters included in this unit. These appear in the teacher edition only and should be used with objectives as indicated below.

TM 1—Poisonous Plants (Objective 5)

TM 2—Components of the Fire Triangle (Objective 6)

TM 3—Classes of Fires and Their Fire Extinguisher Symbols
(Objectives 9 and 10)

TM 4—How to Lift Safely (Objective 12)

TM 5—How to Lift Safely (Continued) (Objective 12)

- Use the following student supplements to enhance your delivery and application.

SS 1—A Systematic Look at First Aid (Introduction)

SS 2—Using the Heimlich Maneuver (Objective 2—choking)

SS 3—Livesaving Facts About Hypothermia (Objective 2—heat stroke)

SS 4—Using Portable Fire Extinguishers (Objective 10)

SS 5—Using a Fire Extinguisher (Objective 10)

SS 6—Guidelines for Interpreting Material Safety Data Sheets.
(Objective 11)

SS 7—Sample MSDSs (Objective 11 and Assignment Sheet 4)

Suggested Activities

- Select teacher components (written test, unit review, teacher supplements) you want to distribute to your students. Copy and prepare these components for distribution.
- Prepare classroom. Put up posters and charts and display articles and other references related to this unit.
- Post copies of the correct lifting procedures and classes of fires and their fire extinguisher symbols which are printed in the transparency master section of this unit.

Delivery and Application

- Discuss unit and specific objectives.
- Discuss information sheets. Implement teaching plan to localize, supplement, and personalize the unit. Reinforce basic academic and workplace skills when applicable.
- Discuss the assignment sheets and job sheets. Review with students the criteria for evaluation of these activities.

Teaching Suggestions

The skill areas appearing in bold-face type in the additional activities refer to the academic and workplace skills identified in *What Work Requires of Schools: A SCANS Report for America 2000* and *Workplace Basics: The Skills Employers Want*. These have been adapted by MAVCC.

- Invite a certified Red Cross instructor, EMT, and/or rescue team member to discuss and demonstrate proper first aid procedures. Arrange for a practice dummy for students to practice CPR techniques and/or the Heimlich maneuver. **(Listening; speaking; applying scientific knowledge)**
- If your class does not have a first-aid kit, have students assemble a first aid kit to take on field trips. (See Objective 3.) **(Acquiring needed resources; teamwork)**
- Arrange for a naturalist or reptile specialist to conduct a live-animal demonstration for class members, to enable them to see various species of poisonous and non-poisonous snakes, spiders, and lizards. Conduct a question and answer period following the demonstration. **(Listening; speaking; acquiring scientific information)**
- Obtain a compact snake bite kit for demonstration purposes. Lead the class in a discussion concerning the use of the various items found in the kit. **(Listening; speaking; acquiring life-saving information)**

Suggested Activities

- Check with your local fire department about the possibility of having a department representative demonstrate the use of several common types of fire extinguishers. Ask if the department has a safe area where students can learn to put out fires using portable fire extinguishers. If so, have students complete Student Supplement 5. If not, have the fire department assist you in establishing a safe area for students to practice using a fire extinguisher. **(Listening; following directions)**
- Arrange for students to take a hunter safety education class. This could be at your school, a local office, or other location. Have students complete the instruction and gain certification. **(Listening; following directions; acquiring life-saving information)**
- Teach a safety lesson dealing with boating, fishing, snowmobiling, or other outdoor recreation activities in which your students may participate. **(Listening; following directions; acquiring life-saving information)**

Evaluation

- Give and evaluate Outdoor Safety and First Aid Review
- Copy written test and give to students as pretest.
- Evaluate assignment sheets. See the evaluation criteria listed at the top of each assignment sheet. Evaluation criteria may be localized, personalized, or individualized to fit your situation. Record student's grade in your grade book.
- Evaluate the job sheets. See the evaluation criteria listed at the top of each job sheet. Evaluation criteria may be localized, personalized, or individualized to fit your situation. Record student's grade in your grade book.
- Give and evaluate written test. Record student's written test score in your grade book and on the student's competency profile.
- Measure competency gains by comparing written pretest scores with posttest scores.
- Meet individually with students to evaluate their progress through this unit of instruction and indicate to them possible areas of improvement.
- Reteach and retest as required.

Suggested Activities

Instructions for Evaluating Student Performance

- When the student is ready to perform a specific task, obtain a copy of the assignment sheet or job sheet which may be found in the student workbook.

Assignment Sheets—Once the student has completed an assignment sheet, evaluate the student's work using the evaluation criteria. If the student's work is unsatisfactory, have the student review the assignment sheet and submit their work for evaluation again. Record the appropriate level of competency on the student's competency profile.

Job Sheets—A student may be evaluated for process, product, or both.

Process evaluation—Place a mark in the box to the left of each designated checkpoint if the student has satisfactorily completed the process step(s) for each checkpoint area. If the student is unable to complete the procedure correctly, have the student review the materials and try again.

Product evaluation—Once the student has satisfactorily completed the procedure, rate the student product (outcome) using the criteria which have been provided as part of the job sheet. If the student's product is unacceptable, have the student review the materials and submit another product for evaluation.

Record the appropriate level of competency on the student's competency profile.

- Sample performance evaluation keys have been provided below. Many other keys are available. Select one rating (grading scale) that best fits your program needs.

Option A

4—**Skilled**—Can perform job with no additional training.

3—**Moderately skilled**—Has performed job during training program; limited additional training may be required.

2—**Limited skill**—Has performed job during training program; additional training is required to develop skill.

1—**Unskilled**—Is familiar with process, but is unable to perform job.

0—**No exposure**—No information or practice provided during training program

Option B

Yes—Can perform job with no additional training.

No—Is unable to perform job satisfactorily.

- Encourage students to begin their portfolio. The portfolio should become a record of the student's progress in the study of natural resources.

Suggested Activities

Resources Used in Developing This Unit

- *Family Medical Guide*. New York, NY: Better Homes and Gardens Books, Meredith Corporation, 1993.
- *Forestry*. Stillwater, OK: Curriculum and Instructional Materials Center, Oklahoma Department of Vocational and Technical Education, 1988.
- *Grollier's Academic American Encyclopedia*. Columbus, OH: CompuServe, Inc., 1994.
- *Introduction to Hospitality and Tourism*. Stillwater, OK: Mid-America Vocational Curriculum Consortium, 1993.
- *Oklahoma Hunter Education Manual*. Seattle, WA: Outdoor Empire Publishing, Inc. 1993.

Suggested Supplemental Resources

Note: URLs change frequently. Any of the web sites listed below may have moved.

- *Interactive Safety Training CD-ROM Set*, Multistate Academic and Vocational Curriculum Consortium, 1500 W. Seventh Avenue, Stillwater, OK, or www.mavcc.org
(CD-ROMs may be purchased individually or in a set. Each interactive training program includes full-motion video and allows you to track and document student training performance. The training, testing, and documentation are all on one CD-ROM. Students can watch the video on any PC, take the test and get immediate results. Test scores are automatically tracked and results are printed at the end of training, or can be imported into your database. CD-ROM interactive training allows students to train on an individual basis at their convenience. Titles include: Hearing Conservation, Respirator Safety, Bloodborne Pathogens, Hazard Communication, First Aid, Hand and Power Tool Safety, Eye Protection, Fire Extinguisher Use, Electrical Safety, Safe Lifting, Personal Protective Equipment, and Slips, Trips, and Falls.)
- *First Aid Fast*, American Red Cross (contact your local Red Cross Chapter or www.redcross.org)
(An illustrated quick-reference guide that provides first aid essentials. It is well-organized and easy to use. It provides step-by-step guidance for the following emergencies: breathing emergencies; cardiac emergencies; injuries to muscles, bones, and joints; poisonings; and much more. Sized to fit in a purse or briefcase, backpack or first aid kit.)
- American Red Cross and Kathleen A. Handal, M.D., *The American Red Cross First Aid and Safety Handbook*, American Red Cross (contact local Red Cross Chapter or purchase at www.amazon.com)
- Auerbach, Paul S., *Medicine for the Outdoors: The Essential Guide to Emergency Medical Procedures and First Aid* (available from www.amazon.com)

Suggested Activities

- Camp, William G. and Thomas Daughtery, *Managing Our Natural Resources* (4th Edition). Albany, NY, Delmar, a division of Thomson Learning, Inc., 2002.
- Lee, Jasper S., *Natural Resources and Environmental Technology*. Danville, IL, IST, Interstate Publishers, Inc., 2000.
- Conant, Roger. *A Field Guide to Reptiles and Amphibians: Eastern and Central North America*. Boston, MA: Houghton Mifflin Company, 1998. (Note: one of Peterson Field Guide Series available at www.amazon.com)
- *Fire Service First Responder*, 1st ed. Stillwater, OK: International Fire Service Training Association/Fire Protection Publications, 2000. (for products and services contact at www.ifsta.org)
- *MSDS Pocket Dictionary*. Schenectady, NY: Genium Publishing Corporation, 1989.
- Bob Jenni Nature Center, 4601 East 2nd, Edmond, Oklahoma 73034. (405) 340-8105. (Outdoor educational material and presentations)
- *Wilderness First Aid: Emergency Care for Remote Locations*, National Safety Council, Public Relations Department, 1121 Spring Lake Drive, Itasca, IL 60143-3201. Phone: (708) 7752307. (for educational materials and videos contact at www.nsc.org)
- USDA Forest Service web site www.fs.fed.us
(Has several links to: Tick Borne Diseases; Wilderness Safety; Safety Concerns: Poison Plants. Also, check out free-loan lending video library system.)

Suggested Lesson Plan

Day 1

Introduction:

- Discuss unit objective and review specific objectives and plan for completing this unit.
- Have students read introductory statement.
- Discuss the importance of studying Outdoor Safety and First Aid.
- State the objectives for today's lesson.

Delivery and Application:

- Have students read Student Supplement 1—A Systematic Look at First Aid.
- Discuss Student Supplement 1.
- Discuss Objective 2—Basic first aid procedures for emergency situations.
 - a. Bleeding.
 - b. Burns.
 - c. Traumatic shock.

Closure:

- Review Student Supplement 1.

Evaluation:

- Non-applicable.

Day 2

Introduction:

- Review Objective 2—bleeding, burns, and traumatic shock.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 2—Basic first aid procedures for emergency situations.
 - d. Falls.
 - e. Choking.
 - Have students read Student Supplement 2—Using the Heimlich Maneuver.
 - Demonstrate the use of the Heimlich Maneuver.
 - Have students return demonstration using Job Sheet 1—Demonstrate the Heimlich Maneuver for an Adult Choking Victim.

Closure:

- Review Objective 2—falls and choking.

Evaluation:

- Evaluate student performance on Job Sheet 1 according to criteria listed on job sheet.
- Record performance grade in grade book.
- Record competency level on student's competency profile.

Suggested Lesson Plan

Day 3

Introduction:

- Return student's job sheets and discuss use of the Heimlich Maneuver.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 2—Basic first aid procedures for emergency situations.
 - f. Electrical accident.
 - g. Heat exhaustion.
 - h. Heat stroke.
- Have students read Student Supplement 3—Lifesaving Facts About Hypothermia.
- Discuss Student Supplement 3.
- Have students complete Assignment Sheet 1—Read Wind Chill Index and Water Survival Charts.

Closure:

- Review Objective 2—electrical accidents, heat exhaustion, and heat stroke.

Evaluation:

- Evaluate student performance on Assignment Sheet 1 according to criteria listed on assignment sheet.
- Record assignment sheet grade in grade book.
- Record competency level on each student's competency profile.

Day 4

Introduction:

- Review Student Supplement 3.
- Pass back student papers and review answers to Assignment Sheet 1.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 2—Basic first-aid procedures for emergency situations.
 - i. Mild hypothermia.
 - j. Moderate hypothermia.
 - k. Severe hypothermia.
 - l. Animal bite.
 - m. Insect stings.
- Discuss Objective 4—Types of poisonous snakes.
 - a. Coral snake.
 - b. Pit vipers.
- Discuss Objective 2—Basic first aid procedures for emergency situations.
 - n. Snake bite.

Closure:

- Review Objective 2—mild hypothermia, moderate hypothermia, and severe hypothermia.

Evaluation:

- Non-applicable.

Suggested Lesson Plan

Day 5

Introduction:

- Review Objective 2—Animal bite, insect bites, and snake bite.
- Review Objective 4—Types of poisonous snakes.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 2—Basic first aid procedures for emergency situations.
 - o. Tick bites.
- Discuss Objective 6—Types of poisonous spiders.
- Discuss Objective 2—Basic first aid procedures for emergency situations.
 - p. Spider bites.

Closure:

- Review Objective 2—tick bites and spider bites.

Evaluation:

- Non-applicable.

Day 6

Introduction:

- Review Objective 6—Types of poisonous spiders.
- Review Objective 2—bleeding, burns, traumatic shock, falls, choking, electrical accident, heat exhaustion, heat stroke, mild hypothermia, moderate hypothermia, severe hypothermia, animal bite, insect stings, snake bite, tick bites, and spider bites.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 3—Contents of a basic first aid kit.

Closure:

- Review basic first aid and contents of a basic first aid kit.

Evaluation:

- Non-applicable.

Day 7

Introduction:

- Review Objective 3—Contents of a basic first aid kit.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 5—Types of poisonous plants.
- Use TM 1 to illustrate types of poisonous plants.
- Discuss Objective 7—Safety precautions to take in inclement weather.

Closure:

- Review Objective 5—Types of poisonous plants.

Evaluation:

- Non-applicable.

Suggested Lesson Plan

Day 8

Introduction:

- Review Objective 7—Safety precautions to take in inclement weather.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 8—Components of a fire triangle.
- Use TM 2 to illustrate components of a fire triangle.
- Discuss Objective 9—Classes of fires and their definitions.
- Discuss Objective 10—Types of fire extinguishers and classes of fires they were designated to extinguish.
- Use TM 3 to illustrate classes of fires and their fire extinguisher symbols.
- Have students read Student Supplement 4—Using Portable Fire Extinguishers.
- Have students complete Assignment Sheet 2—Interpret Portable Fire Extinguisher Symbols.

Closure:

- Review Objectives 8 and 9.

Evaluation:

- Evaluate student performance on Assignment Sheet 2 according to criteria listed on assignment sheet.
- Record assignment sheet grade in grade book.
- Record competency level on student's competency profile.

Day 9

Introduction:

- Return Assignment Sheet 2 and review answers.
- Review Objective 10 and Student Supplement 4.
- State the objectives for today's lesson.

Delivery and Application:

- Demonstrate how to operate a fire extinguisher using Student Supplement 5—Using a Fire Extinguisher.
- Review Objectives 2 through 10; Student Supplements 1, 2, 3, 4, and 5; Assignment Sheets 1 and 2; and Job Sheet 1.
- Have Students begin completing Outdoor Safety and First-Aid Review.

Closure:

- Review Objective 2.

Evaluation:

- Non-applicable.

Suggested Lesson Plan

Day 10

Introduction:

- Review students' progress on Outdoor Safety and First Aid Review.
- State the objectives for today's lesson.

Delivery and Application:

- Have students complete Outdoor Safety and First Aid Review.
- Have students complete Assignment Sheet 3—Analyze Scenarios to Determine Appropriate Safety and First Aid Procedures.

Closure:

- Review Objective 2.

Evaluation:

- Evaluate student performance on Outdoor Safety and First Aid Review according to criteria listed.
- Record Outdoor Safety and First Aid Review grade in grade book.
- Evaluate student performance on Assignment Sheet 3 according to criteria listed on assignment sheet.
- Record assignment sheet grade in grade book.
- Record competency level on each student's competency profile.

Day 11

Introduction:

- Return Assignment Sheet 3 and review answers.
- Return Outdoor Safety and First Aid Review and review answers with students.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 11—Purposes of a material safety data sheet (MSDS)
- Have students read Student Supplement 6—Guidelines for Interpreting Material Safety Data Sheets.
- Have students begin completing Assignment Sheet 4—Interpret Material Data Safety Sheets using information from Student Supplement 7—Sample MSDS.

Closure:

- Review Objective 11.

Evaluation:

- Non-applicable.

Day 12

Introduction:

- Review students' progress on Assignment Sheet 4.
- State the objectives for today's lesson.

Delivery and Application:

- Have students complete Assignment Sheet 4.
- Assign written test on unit (Day 14).
- Assign Assignment Sheet 5—Analyze Current Reports Concerning Outdoor Safety and First Aid (due class period 15).
- Discuss Objective 12—Guidelines for lifting and carrying items safely.

Suggested Lesson Plan

Day 13

Closure:

- Review Objective 12.

Evaluation:

- Evaluate student performance on Assignment Sheet 4 according to criteria listed on assignment sheet.
- Record assignment sheet grade in grade book.
- Record competency level on each student's competency profile.

Introduction:

- Return Assignment Sheet 4 and discuss answers.
- Review progress on Assignment Sheet 5.
- Remind students of written test on Day 14.
- Review Objective 12.
- State the objectives for today's lesson.

Delivery and Application:

- Demonstrate lifting a heavy object properly.
- Use TM 4 and TM 5 to illustrate guidelines for lifting and carrying items safely.
- Have students return demonstration by using Job Sheet 2—Lift a Heavy Object Properly.
- Have students that have completed return demonstration begin review for written test.

Closure:

- Review Objective 12.

Evaluation:

- Evaluate student performance on Job Sheet 2 according to criteria listed on job sheet.
- Record performance grade in grade book.
- Record competency level on each student's competency profile.

Day 14

Introduction:

- Review progress on Assignment Sheet 5.
- Review for written test (cover terms and definitions).
- State the objectives for today's lesson.

Delivery and Application:

- Give written test.
- Have students that have completed the written test work on Assignment Sheet 5.

Closure:

- Review expectations for Assignment Sheet 5.

Suggested Lesson Plan

Day 15

Evaluation:

- Evaluate written test.
Note: Develop teaching strategies for students' who did not achieve 100%.
- Record written test grade in grade book.
- Record written test score on each student's competency profile.

Introduction:

- Return written test and review answers.
- Discuss strategies for students' who did not achieve a 100% score on written test.
- State the objectives for today's lesson.

Delivery and Application:

- Provide supervised study for students to complete Assignment Sheet 5.

Closure:

- Review unit objectives.
- Review next lesson.

Evaluation:

- Evaluate student performance on Assignment Sheet 5 according to criteria listed on assignment sheet.
- Record assignment sheet grade in grade book.
- Record competency level on each student's competency profile.

Outdoor Safety and First Aid Review

Name _____ Overall Rating _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate serious effort was taken in completing review	_____

Introduction

Outdoor work and recreation can be quite rewarding and safe. However, accidents and injuries can happen, so it is important for those involved in outdoor activities to be familiar with outdoor hazards and be able to handle emergency situations.

Directions

Answer the following questions concerning basic safety and first aid procedures for emergency situations. For help, refer to the information sheets and student supplements found in this unit. Circle the correct response for each question.

- _____ is defined as immediate temporary care given the victim of an accident or sudden illness or trauma until the services of a physician can be obtained.
 - Antiseptic
 - First aid
 - Heimlich maneuver
 - Cardiopulmonary resuscitation (CPR)
- Any suddenly occurring, unintentional event that causes injury or property damage is referred to as:
 - Accident
 - Hazard
 - Safety
 - Heat stroke
- _____ is defined as failure to think before one acts; failure to pay attention.
 - Hazard
 - Safety
 - Accident
 - Carelessness
- _____ is defined as the state or condition of being safe; freedom from danger, risk, or injury.
 - Safety
 - First aid
 - Grounded
 - Habitat

Review

5. For minor cuts or bleeding, _____ should be applied.
 - a. elevation
 - b. manual pressure
 - c. a tight tourniquet
 - d. antiseptic solution or cream
6. The proper emergency procedure for a first degree burn is to:
 - a. Flush skin thoroughly with clean water and seek medical attention.
 - b. Hold under cold water, then apply dry, sterile dressing.
 - c. Cool with a damp compress, taking care not to break the blisters, then cover with a dry, sterile dressing to prevent infection.
 - d. Cool with a damp compress and then cover with a dry, sterile dressing; cover the victim with a blanket, elevate feet and legs to prevent shock and loss of body heat.
7. For a third-degree burn:
 - a. Flush skin thoroughly with clean water and seek medical attention.
 - b. Hold under cold water, then apply dry, sterile dressing.
 - c. Cool with a damp compress, taking care not to break the blisters, then cover with a dry, sterile dressing to prevent infection.
 - d. Cool with a damp compress and then cover with a dry, sterile dressing; cover the victim with a blanket, elevate feet and legs to prevent shock and loss of body heat.
8. The proper emergency procedure for a chemical burn is to:
 - a. Flush skin thoroughly with clean water and seek medical attention.
 - b. Hold under cold water, then apply dry, sterile dressing.
 - c. Cool with a damp compress, taking care not to break the blisters, then cover with a dry, sterile dressing to prevent infection.
 - d. Cool with a damp compress and then cover with a dry, sterile dressing; cover the victim with a blanket, elevate feet and legs to prevent shock and loss of body heat.
9. For a second-degree burn:
 - a. Flush skin thoroughly with clean water and seek medical attention.
 - b. Hold under cold water, then apply dry, sterile dressing.
 - c. Cool with a damp compress, taking care not to break the blisters, then cover with a dry, sterile dressing to prevent infection.
 - d. Cool with a damp compress and then cover with a dry, sterile dressing; cover the victim with a blanket, elevate feet and legs to prevent shock and loss of body heat.

10. Shock may be defined as:
 - a. Procedure for forcing a foreign object from the windpipe of a choking victim.
 - b. Immediate temporary care given the victim of an accident.
 - c. Electrical connection to an object that conducts electrical current to the earth.
 - d. A medical condition in which the operation of the circulatory system is partially or completely impaired by the body's reaction to injury or psychic disturbance.
11. First aid for a fall victim with head injuries should include laying the victim flat and:
 - a. apply mouth-to-mouth resuscitation.
 - b. immediately move victim to safe area.
 - c. control bleeding and shock.
 - d. elevating the legs.
12. You are sitting in a restaurant and a diner near your table frantically stands up, grasps his throat, struggles and falls unconscious near your table. What should be done immediately in this case?
 - a. Administer CPR.
 - b. Cover diner to prevent loss of body heat.
 - c. Perform the Heimlich maneuver.
 - d. Hit the diner on the back to dislodge obstacle.
13. The **first** thing you should do when approaching a victim of an electrical accident.
 - a. Administer CPR.
 - b. Do **NOT** provide any assistance until all electrical current has been shut off.
 - c. Treat for traumatic shock.
 - d. Always look for both an entrance and an exit wound with an electrical burn.
14. The **first** action necessary to aid a person suffering from heat exhaustion is:
 - a. provide the victim with a sports drink.
 - b. give the victim liquor.
 - c. move victim to a cool place.
 - d. walk victim around to cool off.

Review

15. Heat stroke may be defined as:
 - a. Muscular pains and spasms due to loss of salt through sweating.
 - b. Immediate life-threatening emergency in which the victim has extremely high body temperature and a failure of the sweating mechanism.
 - c. Below normal body temperature usually due to overexposure to low temperatures.
 - d. Fatigue, weakness, and sometimes collapse due to loss of body fluids through sweating and lack of adequate water intake.
16. Hypothermia is:
 - a. Above normal body temperature usually due to overexposure to high temperatures.
 - b. Below normal body temperature usually due to overexposure to low temperatures.
 - c. Tissue damage due to freezing of tissue fluids.
 - d. Danger of prolonged exposure to heat.
17. Animal bites should be treated as any other cut, scrape, or abrasion with the exception of what consideration:
 - a. Possibility of Rocky Mountain Fever.
 - b. If bite is on the face.
 - c. Possibility of rabies infection.
 - d. Possibility of Lyme disease.
18. In case of a bee sting, the insect's stinger is still embedded in the victim's skin. You should:
 - a. pinch the stinger to remove.
 - b. scrape stinger sideways to remove.
 - c. remove stinger with tweezers.
 - d. apply hot and cold compresses.
19. Select the true statement concerning first aid procedures for snake bites from pit vipers.
 - a. The victim should be encouraged to run, or at least hurry, to the nearest vehicle or emergency station.
 - b. Immobilize the victim. Have him or her lie down and keep quiet.
 - c. Give victim liquor.
 - d. A tight tourniquet should be applied at the wound to cut off circulation and all possible movement of injected venom.

Review

20. Remove an embedded tick with:
 - a. the thumb and forefinger.
 - b. a burning cigarette.
 - c. tweezers.
 - d. a knife.
21. Once cold water or ice and a topical antiseptic are applied to a spider bite, what pain relievers are recommended?
 - a. aspirin or acetaminophen
 - b. cold sports drink
 - c. rest
 - d. any toxin
22. The venom of pit vipers (rattlesnakes, copperheads, and cottonmouths) affects which of the following body systems?
 - a. The nervous system.
 - b. The circulatory system
 - c. The urinary system.
 - d. The digestive system.
23. Select the true statement concerning poisonous plants found in the U.S.
 - a. Poison Ivy is found in all states of the U.S.
 - b. Poison Oak and Poison Ivy are the same plant.
 - c. Poison Ivy is known for its three glossy leaflets.
 - d. Poison Sumac grows only in a vine form.
24. A black widow spider:
 - a. Has a dark tan brown body with lighter brown head; dark "fiddle or violin" design on back of thorax.
 - b. Bite area swells painfully and grows hard.
 - c. Has a shiny black body with red to orange "hour glass" design on its abdomen.
 - d. Bite area may leave severe scars.
25. To protect oneself from lightning while in rural areas take shelter:
 - a. Under a canopy of trees.
 - b. In the open country.
 - c. On a hilltop.
 - d. In a vehicle with the windows rolled up.
26. If a tornado is approaching, seek shelter in:
 - a. low lying areas
 - b. a mobile home
 - c. under a canopy of trees
 - d. in a vehicle with all of the windows rolled up except one on the downwind side

Review

27. For a fire to burn, _____ must be available in the air.
- a. Fuel b. Heat c. Oxygen
28. _____ is anything that burns at the fire site.
- a. Fuel b. Heat c. Oxygen
29. _____ comes from the fire itself.
- a. Fuel b. Heat c. Oxygen
30. Fires that occur with combustible metals such as magnesium, phosphorus, or sodium are:
- a. Class A c. Class C
b. Class B d. Class D
31. Fires that occur in ordinary combustible materials such as wood, rags, paper, and rubbish are:
- a. Class A c. Class C
b. Class B d. Class D
32. Fires that occur in or near electrical equipment such as motors, switchboards, and electrical wiring are:
- a. Class A c. Class C
b. Class B d. Class D
33. Fires that occur with flammable liquids such as gasoline, oil, grease, paint solvent, and thinners are:
- a. Class A c. Class C
b. Class B d. Class D

Outdoor Safety and First Aid Review—Answer Key

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate serious effort was taken in completing review	_____

1. _____ is defined as immediate temporary care given the victim of an accident or sudden illness or trauma until the services of a physician can be obtained.
 - a. Antiseptic
 - b. **First aid**
 - c. Heimlich maneuver
 - d. Cardiopulmonary resuscitation (CPR)
2. Any suddenly occurring, unintentional event that causes injury or property damage is referred to as _____.
 - a. **Accident**
 - b. Hazard
 - c. Safety
 - d. Heat stroke
3. _____ is defined as failure to think before one acts; failure to pay attention.
 - a. Hazard
 - b. Safety
 - c. Accident
 - d. **Carelessness**
4. _____ is defined as the state or condition of being safe; freedom from danger, risk, or injury.
 - a. **Safety**
 - b. First aid
 - c. Grounded
 - d. Habitat

Review—Answer Key

5. For minor cuts or bleeding, _____ should be applied.
- a. elevation
 - b. manual pressure
 - c. a tight tourniquet
 - d. **antiseptic solution or cream**
6. The proper emergency procedure for a first-degree burn is to _____
- a. Flush skin thoroughly with clean water and seek medical attention.
 - b. **Hold under cold water, then apply dry, sterile dressing.**
 - c. Cool with a damp compress, taking care not to break the blisters, then cover with a dry, sterile dressing to prevent infection.
 - d. Cool with a damp compress and then cover with a dry, sterile dressing; cover the victim with a blanket, elevate feet and legs to prevent shock and loss of body heat.
7. For a third-degree burn, _____
- a. Flush skin thoroughly with clean water and seek medical attention.
 - b. Hold under cold water, then apply dry, sterile dressing.
 - c. Cool with a damp compress, taking care not to break the blisters, then cover with a dry, sterile dressing to prevent infection.
 - d. **Cool with a damp compress and then cover with a dry, sterile dressing; cover the victim with a blanket, elevate feet and legs to prevent shock and loss of body heat.**
8. The proper emergency procedure for a chemical burn is to _____
- a. **Flush skin thoroughly with clean water and seek medical attention.**
 - b. Hold under cold water, then apply dry, sterile dressing.
 - c. Cool with a damp compress, taking care not to break the blisters, then cover with a dry, sterile dressing to prevent infection.
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Review—Answer Key

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 - c. On a hilltop.
 - d. **In a vehicle with the windows rolled up.**
26. If a tornado is approaching, seek shelter in:
- a. **low lying areas**
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29. _____ comes from the fire itself.
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b. Class B d. Class D
31. Fires that occur in ordinary combustible materials such as wood, rags, paper, and rubbish are _____
- a. Class A c. Class C
b. Class B d. Class D
32. Fires that occur in or near electrical equipment such as motors, switchboards, and electrical wiring as _____
- a. Class A c. Class C
b. Class B d. Class D
33. Fires that occur with flammable liquids such as gasoline, oil, grease, paint solvent, and thinners are:
- a. Class A c. Class C
b. Class B d. Class D

Unit 1

Outdoor Safety and First Aid

Answers to Assignment Sheets

Assignment Sheet 1

Read Wind Chill Index and Water Survival Charts

See answer key

Assignment Sheet 2

Interpret Portable Fire Extinguisher Symbols

See answer key

Assignment Sheet 3

Analyze Scenarios to Determine Appropriate Safety and First Aid Procedures

See answer key

Assignment Sheet 4

Interpret Material Safety Data Sheets

See answer key

Assignment Sheet 5

Analyze Current Reports Concerning Outdoor Safety and First Aid

Student performance should be evaluated according to criteria listed on the assignment sheet.

Unit 1

Outdoor Safety and First Aid

Objective 13

Assignment Sheet 1—Read Wind Chill Index and Water Survival Charts—Answer Key

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers are correct	_____

Introduction

As information in this unit has shown, survival in cold conditions becomes more difficult as temperatures drop and winds increase. This exercise will sharpen your chart reading skills and will reinforce the importance of taking precautions to protect yourself in cold conditions.

Directions

Read the following scenarios and answer the questions accompanying each according to the charts printed here.

Water Survival Chart		
If the Water Temp. (°F) is...	Exhaustion or Unconsciousness Occurs In...	Expected Time of Survival is...
32.0	Under 15 Minutes	Under 15-45 Minutes
32.5-40.0	15-30 Minutes	30-90 Minutes
40-50	30-60 Minutes	1-3 Hours
50-60	1-2 Hours	1-6 Hours
60-70	2-7 Hours	2-40 Hours
70-80	3-12 Hours	3-Indefinitely
over 80	Indefinitely	

- What is the expected time of survival of a human in the water if the water temperature is 57° F?

1 to 6 hours

Assignment Sheet 1—Answer Key

2. Water temperatures at the sinking of the *Titanic* in 1912 were estimated to be about 32° F. How long do you think most victims survived in the icy waters around the sinking ship?

under 15 minutes to 45 minutes

3. As the result of a night boating accident an individual is pitched into 45° F water. Although the victim is wearing a life preserver, unconsciousness from hypothermia can be expected to occur in 30 to 60 minutes.

Wind Chill Index													
Estimated Wind Speed in MPH	Actual Thermometer Reading (°F)												
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60	
Calm	Equivalent Temperature (°F)												
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60	
	5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-88
	10	40	28	16	4	-9	-21	-38	-46	-58	-70	-83	-95
	15	36	22	9	-5	-18	-36	-45	-58	-72	-88	-89	-112
	20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-124
	25	30	16	0	15	-29	-44	-59	-74	-83	-104	-118	-133
	30	28	13	-2	-18	-33	-48	-63	-79	-94	-107	-128	-140
	35	27	11	-4	-20	-35	-49	-67	-82	-98	-113	-129	-145
	40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	Little Danger* (for properly clothed person)				Increasing Danger*				Great Danger*				
	*Danger From Freezing of Exposed Flesh												

4. If the actual thermometer reading is 50° F. and the wind is 30 miles per hour, what is the equivalent wind chill reading? 28 degrees F
5. Given a winter afternoon temperature reading of 10° F. and north wind of 20 mph per hour, the equivalent wind chill reading is -25 degrees F
6. The wind chill reading is -2° F. and the wind speed is 30 miles per hour. What is the actual thermometer reading? 30 degrees F

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Objective 14

Assignment Sheet 2—Interpret Portable Fire-Extinguishing Symbols—Answer Key

Evaluation Criteria	Rating
• Directions have been followed	_____
• All answers are correct	_____

Introduction

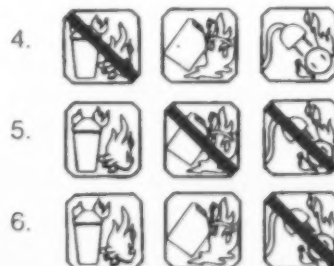
When a fire occurs, it is very important not only to be able to size-up and identify the type of fire, but also to choose an extinguisher that will be effective in putting out the fire.

Directions

Review the material presented in Objective 10 of the information sheet, and locate and study the information presented in Student Supplement 4.

Next, read and follow the directions with each item below.

- Match extinguisher picture symbols with the extinguisher's intended applications. Write the corresponding numbers in the blanks provided.



- 6 a. Class A and B fires but not Class C fires
- 2 b. Flammable liquids
- 4 c. Class B and C fires but not Class A fires

Assignment Sheet 2—Answer Key

- 1 d. Ordinary combustibles
- 5 e. Class A fires but not Class B and C fires
- 3 f. Electrical equipment
2. Write on the blank the correct fire-class letter that would appear in the center of each of the following extinguisher symbol shapes. Beside each shape write the color associated with the shape.

B a.  red

A b.  green

D c.  yellow

C d.  blue

3. Complete fire-extinguisher general operating instructions that follow the letters P-A-S-S.
- a. P Pull pin
- b. A Aim nozzle at base of fire
- c. S Squeeze handle
- d. S Sweep nozzle

Objective 15

Assignment Sheet 3—Analyze Scenarios to Determine Appropriate Safety and First-Aid Procedures— Answer Key

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate cognitive grasp of unit information and critical thinking	_____

Introduction

Clear thinking and basic first-aid training are essential to successfully administer helpful assistance to an accident or trauma victim. As you learned from Student Supplement 1, there is a systematic approach to dealing with first-aid emergencies. In this exercise, you will evaluate various scenarios to determine the proper course of action, or to critique the actions taken based on what you have learned from the information in this unit of instruction.

Directions

Read the following scenarios and answer the questions accompanying each.

1. As a member of a construction crew working to develop a riverside rest area for rafters, you return from lunch to find one of your co-workers slumped against a gasoline trenching machine. The machine is still running, its trenching boom deep in a ditch near the restroom complex. Your friend seems to be unconscious. Based on a systematic look at first aid what is the first thing you should do?

According to a systematic look at first aid a "scene survey" should be taken of any emergency situation to determine if intervention would place the rescuer in danger. In this case, with the boom of the trenching machine still deep in the ditch there is a possibility the worker has accidentally brought the machine into contact with a buried electrical cable. If this is the case, the victim and the machine may both present an electrical hazard to the rescuer. Answer should include a taking of a "survey scene" at a minimum, and should include a discussion of possible hazards in this scenario.

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Assignment Sheet 3—Answer Key

2. While fishing at a remote high mountain lake you hear a scraping clattering sound on the rocks behind you. As you turn to investigate, you see a bicyclist obviously out of control, falling head over heels down the mountain side from the trail above. She bounces off one last boulder and lands face down in the water at the edge of the lake. She doesn't move. Although you know her neck might be broken, you can't take a chance on her drowning so you carefully pull her from the water and turn her over to take a closer look. In order, what are the first three things you should determine?

a. Is the AIRWAY clear?

b. Is there evidence of BREATHING?

c. Is there evidence of blood CIRCULATING?

3. Julio and Brett are cataloging various native grasses and forbs on the Rita Blanca National Grasslands in far northwestern Oklahoma on a windy late May afternoon. They have walked nearly a mile from their pickup truck and are engrossed in photographing various specimens of buffalograss and occasional Little bluestem clumps when a lightning bolt from a rapidly approaching thunderstorm strikes a few hundred yards away with a deafening BOOM and a flash of heat. The Rita Blanca is open country with no trees and only occasional outcroppings of volcanic rock and few ravines. Evaluate this situation, giving suggestions on how Julio and Brett might have avoided their situation and what actions they might take to reduce their chance of being struck by lightning.

Answer should refer to the fact weather conditions should be monitored and taken into account before going afield. Also, Julio and Brett should get off the open high ground and take some shelter in any available ravines, then return to their vehicle as soon as possible to seek shelter from the lightning.

Assignment Sheet 3—Answer Key

4. As a newly assigned game ranger, you drive out of town to the end of a nearby reservoir on a sunny pre-duck-season afternoon in December. Although wintry conditions have prevailed for the past month or so, the temperature is relatively warm and you think it might be a good day to watch arriving mallard and pintail ducks as they migrate to the south. It would be a good way to spend your first day off in two weeks—just sitting, drinking from a Thermos bottle of coffee and watching the ducks announce the arrival of winter. Sitting in your pickup on a hill above a neck of the lake where much timber remains in the water, you notice a lone late-season fisherman standing up in his small boat to untangle a fishing line caught in a branch. Suddenly, he falls backward into the 40 degree water. You know he has less than an hour to live if he doesn't get out of the water, so you race your truck across the pastureland to try to give him assistance. Once you arrive at lakeside, you realize the man is wearing a personal flotation device and is awkwardly swimming through the tangles of brush and limbs to shore. As you toss a rope out to him, he grasps at it eagerly and thrashes in the water for several seconds before grabbing it...allowing you to pull him ashore. As he stands in the mud gasping for air, he thanks you profusely and complains of cramping cold muscles. He tries in vain to take off his life vest and begins to shake clumsily as you help him toward your pickup truck. Evaluate this man's condition and suggest several steps that can be taken at the scene to help him recover.

The victim is in a state of mild hypothermia and should be removed from the cold environment as soon as possible. In this case, the victim should be taken to the nearby truck which we assume is equipped with a heater. Also, the ranger should offer warm liquids (in this case the coffee in the Thermos-type container). Also, if possible, the victim should be given warm clothing or blankets after getting out of his wet clothing.

5. On a spring-break picnic Jeanette, Stacey, and Nolini were enjoying the sun, eating hot dogs and potato chips and taking a break from mid-term exams and the rigors of school. In their excitement and laughter, Nolini looked on in horror to see Stacey grabbing her throat, red-faced, and struggling. Immediately Jeanette raced to Stacey and performed the Heimlich maneuver several times until a chunk of frankfurter was dislodged from her throat. Describe the Heimlich maneuver and how it is performed.

Answer should include a discussion and description of the Heimlich maneuver according to Student Supplement 2. Answer should satisfy instructor that thorough understanding of Heimlich maneuver is grasped by the student.

Assignment Sheet 3—Answer Key

6. While hiking alone across a rocky hillside on a sunny late-fall afternoon in south Texas, LeRhonda rounded a bend in the trail and was terrified to see a large diamond-back rattlesnake sunning itself on a waist-high rock only a few feet in front of her. In her surprise, she lost her footing and fell down a cactus-filled rocky embankment. After the initial pain of cuts and bruises and the fear of falling had subsided, LeRhonda realized the sharp pain in her shin was probably the result of a broken leg. Climbing back to the trail was impossible in her condition and night was near, so she removed a nylon windbreaker from her backpack and put it on. She took a drink from her canteen and decided to make the best of it until someone came along the trail above, or she could get herself out of the predicament. The next morning, when two hikers found LeRhonda they found it difficult to communicate with her about what happened because of her incoherent speech patterns and her inability to speak without gasping. It was evident she had vomited several times throughout the night and she was extremely thirsty. In helping her drink, one of her rescuers noticed she felt cold and her pulse was rapid. Evaluate LeRhonda's condition and describe what actions should be taken immediately.

LeRhonda's condition is traumatic shock and the steps to control that shock should be to keep her warm or warm her with blankets and/or body heat, elevate her legs somewhat, and evacuate her to medical care as soon as possible.

7. As an outdoor recreation instructor for a private youth summer camp in central Tennessee, you have been assigned to lead a day-long nature hike for a group of early teens. The route involves paths through stands of hardwood timber, along lake shores and up steep forested paths to panoramic hill tops. You have explained the possibility of encounters with various poisonous plants and the remote, but real, possibility of encounters with poisonous snakes. As you lead your group across the quiet, damp, leaf-littered forest floor, a boy in the back of the group steps over a log and yells as a sharp pain strikes the calf of his leg. "Snake!", he cries, as he hustles back to the group, limping and clutching his leg. You assemble the others and comfort the boy on a clearing near the path. He describes to you a burning sensation on the back of his leg and says he saw a glimpse of a brownish snake, almost the same color as the fallen leaves, crawling to safety beneath the log. Inspecting the boy's leg you find two distinct fang marks in the middle of the calf muscle. Evaluate this situation (what type of snake do you suspect was encountered, and describe appropriate first-aid measures you would apply.)

The hiker apparently has been bitten by a copperhead, a pit viper found in the southeastern two-third of the U.S., given the fang marks and the coloration of the suspected snake. Appropriate first aid in this case would involve keeping the victim calm while a constricting band is placed above the bite (probably just below the knee in this case) and suction applied to the wounds as soon as possible to remove as much venom as possible. Further action would include getting the victim to medical assistance as soon as possible.

Assignment Sheet 3—Answer Key

8. After cooking breakfast over a small open fire at your campsite near a stream in a national forest, you are ready to pack your gear and resume your weeklong hiking vacation. Using your knowledge of the fire triangle, what will you do with the campfire to ensure it will not become a problem after you leave?

To ensure the campfire is no longer active, water from the stream should be used to cool and extinguish the fire. Once the fire is apparently extinguished, the remaining fuel (logs and branches) should be separated somewhat and additional water poured over them to further cool the fuel and rob "hot spots" of oxygen.

9. As a member of a contract crew renovating a playground, you find yourself assigned the task of planting grass on bare spots left by years of hard play. Part of the process involves applying ammonium nitrate fertilizer to the areas to give the new grass adequate fertility to cover the area quickly. You are not familiar with ammonium nitrate and you're not really certain what it is or what hazards it might represent. Where can you get more information about the substance before you begin handling it?

Federal law requires employers to maintain a file of material safety data sheets on various chemicals and materials employees may be asked to handle. In this case asking to read a copy of the MSDS on ammonium nitrate would be the most direct method of learning about the product and its characteristics.

10. As an employee of a recycling business, you are operating a baling machine that compresses scrap paper into 500-pound square bales for shipping. You become aware of a smoky smell drifting through your workplace. Upon investigating further, you find a carelessly discarded cigarette has caused a bin of scrap newsprint to catch fire. With your knowledge of the different types of fire extinguishers and fires, describe the classification of this fire, and what type of fire extinguisher should be readily available to fight it.

A Class A fire extinguisher with some source of pressurized water is the correct answer.

**Assignment Sheet 4—Interpret Material Safety
Data Sheets—Answer Key**

Evaluation Criteria	Rating
• Directions have been followed	_____
• Ability to read and interpret data is evident from student's answers	_____

MSDS 1—Cato Coolant (A typical antifreeze/coolant)

1. What is the main ingredient of this product?

Ethylene glycol and glycols

2. What is the appearance of this product?

Green hygroscopic liquid

Assignment Sheet 4—Answer Key

3. What emergency telephone numbers should one call for problems with this product?

(405) 424-3311 or (800) 424-9300

4. To what temperature must this product be raised before it will ignite?

748 degrees F

5. What type of fire extinguisher may be used on a fire involving this material?

Water spray, carbon dioxide, dry chemical, or foam

6. What hazardous materials can the incomplete combustion of this product cause?

Carbon monoxide and carbon dioxide

7. What effects can this product have if its fumes are inhaled?

Nasal and respiratory irritation, drowsiness, narcosis, unconsciousness

8. How may this product affect the skin?

Possible irritation

9. What may happen if this product is ingested?

Liver, kidney damage, drowsiness, narcosis, uncounsciousness, death

10. In concentrations of up to 500 parts per million, what respiratory protection is needed with this product?

Full-face supplied air respirator

MSDS 2—Sevin 5% Dust (Common garden, lawn, and agricultural insecticide)

1. What is the main ingredient of this product?

Carbaryl

2. What is the appearance of this product?

White to light tan solid

3. What type of fire extinguisher may be used to combat fires involving this material?

Dry chemical or CO₂ for small fires, water spray or foam for large fires.

Assignment Sheet 4—Answer Key

4. What health hazards to the eyes might contact with this material cause?

Irritation, tearing, or redness

5. What may happen if this product is ingested?

May be fatal

6. What symptoms may occur if this product is ingested?

Nausea, vomiting, abdominal pain, diarrhea, pin point pupils, blurred vision, profuse sweating, salivation, tremors, muscle twitching, temporary paralysis, respiratory depression and convulsions

7. What respiratory protection is needed while handling this product?

NIOSH/MSHA approved respirator

8. What skin protection is needed while handling this product?

Chemical-resistant gloves, full-body protective clothing, safety shower

9. What first aid measure should be taken immediately for a victim of inhalation of this product?

Remove patient from immediate source of exposure and assure that the individual is breathing

10. What emergency telephone number is to be used for problems with this product?

(800) 424-9300

MSDS 3—Ammonium Nitrate (Common lawn and agricultural fertilizer)

1. What is the principal hazardous substance in this product?

Ammonium Nitrate

2. What emergency telephone number is to be used for problems with this product?

(919) 763-0171

3. What appearance does this product have?

Solid, white, odorless

4. What is the recommended fire extinguishing agent recommended for fires involving this product?

Large volumes of low pressure water

Assignment Sheet 4—Answer Key

5. What harmful compounds are released when this product burns?

Nitrogen oxide gases

6. What symptoms of acute exposure might be apparent if this product is ingested?

Cyanosis, decrease in blood pressure, rapid heartbeat, rapid breathing, abdominal pain, weakness, and collapse

7. What may happen if this product is inhaled?

Minor respiratory tract irritation

8. What affect does this product have on the skin?

Slight irritation

9. What type of respiratory protection is needed while handling this product?

NIOSH/MSHA approved dust respirator

10. What other protective clothing is needed to handle this material?

None

MSDS 4—Atrazine 4L (Brand name AATREX; common herbicide used in pasture and range renovation)

1. What emergency assistance telephone numbers should be used for problems with this product?

(713) 473-9461 and (800) 424-9300

2. What is the main technical ingredient of this product?

Atrazine

3. In addition to the main technical ingredient, what other compound does this material contain (Component 2)?

Ethylene glycol

4. What may happen if this material is splashed into the eye?

Mild irritation

5. What effect does this material have on the skin?

Minimal irritation

Assignment Sheet 4—Answer Key

6. What organs of the body might be severely affected if this product is ingested?

Kidney

7. What emergency first aid should be administered to a victim whose eyes have come in contact with this material?

Flush eyes with water for 15 minutes

8. What first aid action is required for a victim who has inhaled this product and has difficulty breathing?

Remove victim to fresh air and provide oxygen

9. At what temperature will this product burn?

Will not burn

10. What unusual fire explosion hazards might be released upon combustion?

Nitrogen oxides and nitrogen containing organic compounds

Unit 1

Outdoor Safety and First Aid

Written Test

Name _____

Date _____ Score _____

Objective 1

Match terms related to outdoor safety and first aid with their definitions. Write the corresponding numbers on the blanks provided. Definitions continue on the next page.

- | | | |
|--|------------------------|--------------------------------|
| 1. Accident | 8. Habitat | 15. Material safety data sheet |
| 2. Antiseptic | 9. Hazard | 16. Safety |
| 3. Cardiopulmonary resuscitation (CPR) | 10. Hazardous material | 17. Second-degree burn |
| 4. Carelessness | 11. Heat exhaustion | 18. Shock |
| 5. First aid | 12. Heat stroke | 19. Third-degree burn |
| 6. First-degree burn | 13. Heimlich maneuver | 20. Topical |
| 7. Frostbite | 14. Hypothermia | |

- _____ a. Failure to think before one acts; failure to pay attention
- _____ b. Any suddenly occurring, unintentional event that causes injury or property damage
- _____ c. Tissue damage due to freezing of tissue fluids
- _____ d. Immediate temporary care given the victim of an accident or sudden illness or trauma until the services of a physician can be obtained
- _____ e. A substance that prevents infection by killing bacteria
- _____ f. Burn affecting only the outer skin layers; characterized by redness and pain
- _____ g. The region where a plant or animal naturally grows or lives
- _____ h. Procedure for restoring normal breathing after cardiac arrest

Written Test

- _____ i. Potential source of danger
- _____ j. Any cancer-causing, corrosive, toxic, irritant, oxidizer, or other material that has the potential to damage specific body organs
- _____ k. Fatigue, weakness, and sometimes collapse due to loss of body fluids through sweating and lack of adequate water intake
- _____ l. Form that lists and explains each of the hazardous materials that an employee works with so the employee can safely use the material and respond to emergency situations
- _____ m. Burn that destroys all skin layers and underlying tissue; characterized by charring or white, leathery appearance of the skin and lack of pain
- _____ n. Procedure for forcing a foreign object from the windpipe of a choking victim
- _____ o. A medical condition in which the operation of the circulatory system is partially or completely impaired by the body's reaction to injury or psychic disturbance
- _____ p. Below normal body temperature usually due to overexposure to low temperatures
- _____ q. Burn penetrating beneath the superficial skin layers; characterized by swelling and blisters

Objective 2

Select true statements concerning basic first aid procedures for emergency situations. Place an "X" in the blanks next to the true statements.

- _____ a. Applying antiseptic solution or cream and dress wound with sterile bandages to treat minor bleeding.
- _____ b. Chemical burns should be treated by submerging burned area under cold water, then applying a dry, sterile dressing.
- _____ c. Some early signs and symptoms of traumatic shock include the following: pale or bluish skin; rapid, weak pulse; vomiting or nausea; and excessive thirst.
- _____ d. A victim of traumatic shock should be cooled with a damp cloth to reduce body heat.

Written Test

- _____ e. Do not move a victim or allow victim to move if a neck or back injury is suspected.
- _____ f. A victim who has trouble speaking or breathing, has pale or bluish skin, and loses consciousness is suffering from heat exhaustion.
- _____ g. In the event of an electrical accident, **do not** provide any assistance until all electrical current has been shut off.
- _____ h. A heat stroke victim should be moved immediately to a cool place.
- _____ i. Victims of moderate or severe hypothermia cease shivering.
- _____ j. For animal bites, cleanse wound thoroughly with soap and water and apply antiseptic.
- _____ k. Victims of an allergic reaction to a bee sting should be evacuated to a physician's office or hospital emergency room immediately.
- _____ l. Hot and cold compresses, alternated every 3 to 5 minutes, should be applied on coral snake bites.
- _____ m. Carefully remove an imbedded tick by grabbing the tick between the thumb and forefinger and pulling quickly straight out.
- _____ n. Cold water or ice and a topical antiseptic may be used to treat spider bites.

Objective 3

List ten items that should be found in a basic first aid kit.

- | | |
|----------|----------|
| a. _____ | f. _____ |
| b. _____ | g. _____ |
| c. _____ | h. _____ |
| d. _____ | i. _____ |
| e. _____ | j. _____ |

Written Test

Objective 4

Describe the two types of poisonous snakes found in the United States.

- a. Pit vipers— _____

- b. Coral snake— _____

Objective 5

Distinguish among types of poisonous plants in the United States. Place an "I" for poison ivy, an "O" for poison oak, and an "S" for poison sumac in the blanks next to their characteristics.

- _____ a. Plant grows in shrub and sometimes vine form
- _____ b. Leaves always consist of three glossy leaflets
- _____ c. Grows in most of the eastern third of the United States
- _____ d. Grows as a woody shrub or small tree form 5 to 25 feet tall
- _____ e. Grows in California and parts of adjacent states
- _____ f. Sometimes called yew

Written Test

Objective 6

Distinguish between the two types of poisonous spiders in the United States. Place a "W" for black widow and an "R" for brown recluse in the blanks next to their characteristics.

- _____ a. Bite looks like a pin prick; severe pain caused by nerve toxins begins within minutes accompanied by sweating, cramps, nausea, and difficult speaking and breathing
- _____ b. Found in buildings, closets, old clothes, on undersides of tables and chairs, and under rocks and bark
- _____ c. Dark "fiddle or violin" design on back of thorax
- _____ d. Orange "hour glass" design on its abdomen
- _____ e. Found in trash dumps, ash piles, under boxes, crates, stones and wood piles, and in outdoor toilet facilities
- _____ f. Bite area swells painfully and grows hard; blisters and ulcers form and a rash may cover the body within 24-48 hours; accompanied by chills, vomiting, nausea, and fever.

Objective 7

List two safety precautions to take for each type of inclement weather.

a. Lightning

- _____

- _____

b. Heavy rain

- _____

- _____

Written Test

c. Tornado

- _____

- _____

d. Winter storm

- _____

- _____

Objective 8

Explain how the components of the fire triangle work.

Written Test

Objective 9

Match classes of fires with their definitions. Write the corresponding numbers on the blanks provided.

- | | |
|------------|------------|
| 1. Class A | 3. Class C |
| 2. Class B | 4. Class D |

- _____ a. Fires that occur with combustible metals such as magnesium, phosphorus, or sodium
- _____ b. Fires that occur with flammable liquids such as gasoline, oil, grease, paint, solvent, and thinners
- _____ c. Fires that occur in or near electrical equipment such as motors, switchboards, and electrical wiring
- _____ d. Fires that occur in ordinary combustible materials such as wood, rags, paper, and rubbish

Objective 10

Match types of fire extinguishers with the classes of fires for which they were designed. Write the corresponding numbers on the blanks provided.

- | | |
|------------------------|----------------------|
| 1. Carbon dioxide (CO) | 3. Foam |
| 2. Dry chemical | 4. Pressurized water |

- _____ a. Used on Class A fires
- _____ b. Used on Class A and B fires
- _____ c. Used on Class B and C fires
- _____ d. Used on Class B, C, and D fires

Objective 11

Complete statements concerning purposes of a material safety data sheet (MSDS). Write the correct number on the blank provided before each item.

- _____ a. To inform _____ of the material's physical properties or fast-acting health effects that make it dangerous to handle
 - 1) OSHA
 - 2) the management
 - 3) the user
 - 4) the health department
- _____ b. To tell the user the level of _____ needed
 - 1) protective gear
 - 2) medical care
 - 3) hygiene
 - 4) management

Written Test

_____ c. To tell the user the _____ necessary if exposed to the product or its hazards

- 1) preplanning
- 2) OSHA regulations
- 3) legal actions
- 4) first-aid treatment

_____ d. To tell the management and the user the _____ needed for safety handling spills, fires, and day-to-day operations

- 1) legal actions
- 2) preplanning
- 3) equipment and materials
- 4) personnel resources

_____ e. To tell the user how to _____ accidents

- 1) report
- 2) respond to
- 3) prevent
- 4) record

Objective 12

Complete statements concerning guidelines for lifting and carrying items safely. Write the correct number on the blank provided before each item.

_____ a. Place your _____ as close to the load as possible

- 1) head
- 2) shoulders
- 3) hip
- 4) feet

_____ c. Do not _____ or twist your body to change direction.

- 1) set the load down
- 2) turn your head
- 3) change your grip
- 4) adjust your footing

_____ c. To set the load down, bend your _____

- 1) arms
- 2) knees
- 3) back
- 4) head

*Permission to duplicate this test is granted.

Written Test—Answer Key

Objective 1

Match terms related to outdoor safety and first aid with their definitions. Write the corresponding numbers on the blanks provided. Definitions continue on the next page.

- | | | |
|--|---------------------------|---------------------------|
| 1. Accident | 8. Habitat | 15. Material safety |
| 2. Antiseptic | 9. Hazard | data sheet |
| 3. Cardiopulmonary
resuscitation
(CPR) | 10. Hazardous
material | 16. Safety |
| 4. Carelessness | 11. Heat exhaustion | 17. Second-degree
burn |
| 5. First aid | 12. Heat stroke | 18. Shock |
| 6. First-degree burn | 13. Heimlich
maneuver | 19. Third-degree burn |
| 7. Frostbite | 14. Hypothermia | 20. Topical |

- 4 a. Failure to think before one acts; failure to pay attention
- 1 b. Any suddenly occurring, unintentional event that causes injury or property damage
- 7 c. Tissue damage due to freezing of tissue fluids
- 5 d. Immediate temporary care given the victim of an accident or sudden illness or trauma until the services of a physician can be obtained
- 2 e. A substance that prevents infection by killing bacteria
- 6 f. Burn affecting only the outer skin layers; characterized by redness and pain
- 8 g. The region where a plant or animal naturally grows or lives
- 3 h. Procedure for restoring normal breathing after cardiac arrest

Written Test—Answer Key

- 9 i. Potential source of danger
- 10 j. Any cancer-causing, corrosive, toxic, irritant, oxidizer, or other material that has the potential to damage specific body organs
- 11 k. Fatigue, weakness, and sometimes collapse due to loss of body fluids through sweating and lack of adequate water intake
- 15 l. Form that lists and explains each of the hazardous materials that an employee works with so the employee can safely use the material and respond to emergency situations
- 19 m. Burn that destroys all skin layers and underlying tissue; characterized by charring or white, leathery appearance of the skin and lack of pain
- 13 n. Procedure for forcing a foreign object from the windpipe of a choking victim
- 18 o. A medical condition in which the operation of the circulatory system is partially or completely impaired by the body's reaction to injury or psychic disturbance
- 14 p. Below normal body temperature usually due to overexposure to low temperatures
- 17 q. Burn penetrating beneath the superficial skin layers; characterized by swelling and blisters

Objective 2

Select true statements concerning basic first aid procedures for emergency situations. Place an "X" in the blanks next to the true statements.

- X a. Applying antiseptic solution or cream and dress wound with sterile bandages to treat minor bleeding.
- b. Chemical burns should be treated by submerging burned area under cold water, then applying a dry, sterile dressing.
- X c. Some early signs and symptoms of traumatic shock include the following: pale or bluish skin; rapid, weak pulse; vomiting or nausea; and excessive thirst.
- d. A victim of traumatic shock should be cooled with a damp cloth to reduce body heat.

Written Test—Answer Key

- ☒ e. Do not move a victim or allow victim to move if a neck or back injury is suspected.
- ☐ f. A victim who has trouble speaking or breathing, has pale or bluish skin, and loses consciousness is suffering from heat exhaustion.
- ☒ g. In the event of an electrical accident, **do not** provide any assistance until all electrical current has been shut off.
- ☒ h. A heat stroke victim should be moved immediately to a cool place.
- ☐ i. Victims of moderate or severe hypothermia cease shivering.
- ☒ j. For animal bites, cleanse wound thoroughly with soap and water and apply antiseptic.
- ☒ k. Victims of an allergic reaction to a bee sting should be evacuated to a physician's office or hospital emergency room immediately.
- ☐ l. Hot and cold compresses, alternated every 3 to 5 minutes, should be applied on coral snake bites.
- ☐ m. Carefully remove an imbedded tick by grabbing the tick between the thumb and forefinger and pulling quickly straight out.
- ☒ n. Cold water or ice and a topical antiseptic may be used to treat spider bites.

Objective 3

List ten items that should be found in a basic first aid kit.

Answers may appear in any order:

- | | |
|--|---------------------------------|
| a. Antiseptic to kill bacteria | f. Scissors |
| b. Adhesive bandages | g. Tweezers |
| c. Gauze pads, various sizes | h. Elastic bandages for sprains |
| d. Gauze roller bandages | i. Pain relievers |
| e. Triangle bandages for large wounds and stings | j. Snake bite kit |

Written Test—Answer Key

Objective 4

Describe the two types of poisonous snakes found in the United States.

Answers may be in student's own words, but should include much of the following:

- a. Pit vipers—
 - A pit between the eye and nostril on each side of the face
 - Vertically elliptical pupils
 - Usually two well-developed fangs capable of injecting venom which affects the victim's circulatory system and blood
 - One row of plates beneath the tail
 - Triangle-shaped head with a narrow neck
 - Habitat and color markingsExamples: Copperhead, Cottonmouth, Rattlesnake
- b. Coral snake—
 - Tubular fangs that inject a highly toxic venom which attacks the victim's nervous system
 - Round pupils
 - A double row of plates beneath the tail
 - Colorfully-banded markings of red, yellow, and black rings with red and yellow rings touching
 - A black nose
 - Habitat is eastern, one-third of Texas, southern Arkansas, Louisiana, Mississippi, Alabama, Georgia, Florida, and northward across the coastal plain to southern North Carolina

Objective 5

Distinguish among types of poisonous plants in the United States. Place an "I" for poison ivy, an "O" for poison oak, and an "S" for poison sumac in the blanks next to their characteristics.

- O a. Plant grows in shrub and sometimes vine form
- I b. Leaves always consist of three glossy leaflets
- S c. Grows in most of the eastern third of the United States
- S d. Grows as a woody shrub or small tree form 5 to 25 feet tall
- O e. Grows in California and parts of adjacent states
- O f. Sometimes called yew

Written Test—Answer Key

Objective 6

Distinguish between the two types of poisonous spiders in the United States. Place a "W" for black widow and an "R" for brown recluse in the blanks next to their characteristics.

- W a. Bite looks like a pin prick; severe pain caused by nerve toxins begins within minutes accompanied by sweating, cramps, nausea, and difficult speaking and breathing
- R b. Found in buildings, closets, old clothes, on undersides of tables and chairs, and under rocks and bark
- R c. Dark "fiddle or violin" design on back of thorax
- W d. Orange "hour glass" design on its abdomen
- W e. Found in trash dumps, ash piles, under boxes, crates, stones and wood piles, and in outdoor toilet facilities
- R f. Bite area swells painfully and grows hard; blisters and ulcers form and a rash may cover the body within 24-48 hours; accompanied by chills, vomiting, nausea, and fever.

Objective 7

List two safety precautions to take for each type of inclement weather.

Any two of the following for each type of inclement weather

- a. Lightning
 - Take shelter in a vehicle with windows rolled up or in a building if possible
 - Avoid shelter under trees
 - Avoid hilltops and open country during approach and duration of a thunderstorm
- b. Heavy rain
 - Avoid low-lying areas, or obvious drainage areas when heavy thunderstorms are present (unless the direct approach of a tornado is imminent)
 - Never drive into running water
 - Take lightning precautions

Written Test—Answer Key

Objective 8

c. Tornado

- Seek shelter in low areas
- If no shelter is available, move at right angles to the approach of the funnel cloud
- Do not seek shelter in an automobile or mobile home

d. Winter storm

- Be alert to weather forecasts
- Be prepared with food, water, and sheltering material such as blankets, tents, and candles
- Be alert to hypothermia if stranded in a winter storm
- Take precautions to avoid carbon monoxide poisoning if stranded in a vehicle. Snow may build up around exhaust system.

Explain how the components of the fire triangle work.

Answer may be in student's own words, but should include the following:

The fire triangle represents the three components that are needed for fire.

Combustion can occur only when the fire triangle is complete.

Oxygen must be available in the air and the more oxygen a fire has, the faster and hotter it will burn. Wind brings more oxygen to a fire. Remove the oxygen supply to break the fire triangle.

Fuel is anything that burns at the fire site. Examples are dried grass or leaves, small trees, large trees and limbs, brush, stumps, gasoline, oil, and paper. The arrangement of the fuel will affect the amount of heat. The temperature must be high enough to ignite the fuel. The source of the fuel must be eliminated to stop a fire.

Heat comes from the fire itself, as long as there is plenty of fuel and oxygen, a fire will continue to burn, producing greater heat. The temperature must be high enough to ignite the fuel. Heavy fuels such as logs or lumber burn hotter. When the heat is removed, the fire triangle is broken.

Written Test—Answer Key

Objective 9

Match classes of fires with their definitions. Write the corresponding numbers on the blanks provided.

- | | |
|------------|------------|
| 1. Class A | 3. Class C |
| 2. Class B | 4. Class D |

- 4 a. Fires that occur with combustible metals such as magnesium, phosphorus, or sodium
- 2 b. Fires that occur with flammable liquids such as gasoline, oil, grease, paint, solvent, and thinners
- 3 c. Fires that occur in or near electrical equipment such as motors, switchboards, and electrical wiring
- 1 d. Fires that occur in ordinary combustible materials such as wood, rags, paper, and rubbish

Objective 10

Match types of fire extinguishers with the classes of fires for which they were designed. Write the corresponding numbers on the blanks provided.

- | | |
|------------------------|----------------------|
| 1. Carbon dioxide (CO) | 3. Foam |
| 2. Dry chemical | 4. Pressurized water |

- 4 a. Used on Class A fires
- 3 b. Used on Class A and B fires
- 1 c. Used on Class B and C fires
- 2 d. Used on Class B, C, and D fires

Objective 11

Complete statements concerning purposes of a material safety data sheet (MSDS). Write the correct number on the blank provided before each item.

- 3 a. To inform _____ of the material's physical properties or fast-acting health effects that make it dangerous to handle
- 1) OSHA
2) the management
3) the user
4) the health department
- 1 b. To tell the user the level of _____ needed
- 1) protective gear
2) medical care
3) hygiene
4) management

Written Test—Answer Key

Objective 12

- 4 c. To tell the user the _____ necessary if exposed to the product or its hazards
- 1) preplanning
 - 2) OSHA regulations
 - 3) legal actions
 - 4) first aid treatment
- 2 d. To tell the management and the user the _____ needed for safety handling spills, fires, and day-to-day operations
- 1) legal actions
 - 2) preplanning
 - 3) equipment and materials
 - 4) personnel resources
- 2 e. To tell the user how to _____ accidents
- 1) report
 - 2) respond to
 - 3) prevent
 - 4) record

Complete statements concerning guidelines for lifting and carrying items safely. Write the correct number on the blank provided before each item.

- 4 a. Place your _____ as close to the load as possible
- 1) head
 - 2) shoulders
 - 3) hip
 - 4) feet
- 3 c. Do not _____ or twist your body to change direction.
- 1) set the load down
 - 2) turn your head
 - 3) change your grip
 - 4) adjust your footing
- 2 c. To set the load down, bend your _____.
- 1) arms
 - 2) knees
 - 3) back
 - 4) head

*Permission to duplicate this test is granted.

Poisonous Plants



Poison Sumac



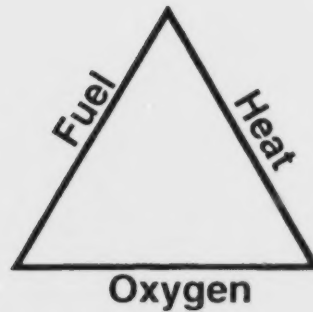
Western Poison Oak



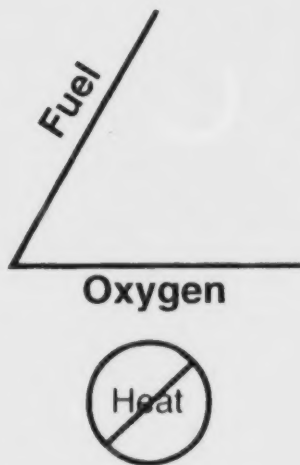
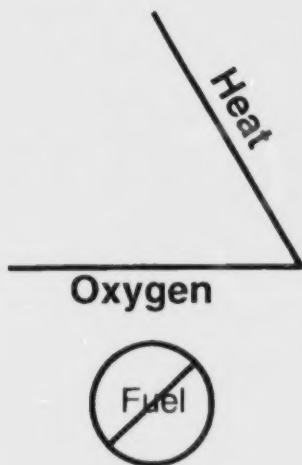
Poison Ivy

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Components of a Fire Triangle



To produce fire, the three elements of the fire triangle must be present at the same time. If any one of the three is missing, a fire cannot be started. With the removal of any one element, the fire will be extinguished.



Classes of Fires and Their Fire Extinguisher Symbols

Class A (Green) • Ordinary combustibles	Class B (Red) • Flammable liquids and gases
Class C (Blue) • Live electrical equipment	Class D (Yellow) • Combustable metals

How to Lift Safely

1

Approach the load and size it up as to weight, size, and shape. Consider your physical ability to handle the load.



2

Place feet close to the object to be lifted and 8 to 12 inches apart for good balance.



3

Bend the knees to the degree that is comfortable and get a good handhold. Then use both legs and back muscles.



4

Lift the load straight up smoothly and evenly. Push with your legs, and keep the load close to your body.



How to Lift Safely (Continued)

5

Lift the object into carrying position, making no turning or twisting movements until the lift is completed..



6

Turn your body with changes of foot position after looking over your path of travel, making sure it is clear



7

Setting the load down is just as important as picking it up. Using leg and back muscles, comfortably lower load by bending your knees. When load is securely positioned, release your grip.



Unit 2

Natural Resources and Conservation

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Instructional
Plan

Suggested Activities

Preparation

- Review the objective sheet. Study the specific objectives to determine the order in which you will present the objectives.
- Review the suggested lesson plan. The plan identifies an order for instruction to take place. Each "day" represents a 50-minute class period. The plan is designed to cover the specific objectives over a 15-day period. Additional days and/or activities may be added. (Note: You may want to change days to specific dates. Example: Day 1 may become Monday, Sept. 5, Day 2 = Tuesday, September 6, and so forth.) You will want to localize, supplement, and personalize the plan to fit your situation.
- Review the teaching suggestions included in this instructional plan section to plan classroom activities. Also note the suggestions for suggested supplemental resources.
- Plan your presentation to take advantage of student learning styles and to accommodate special-needs students.
- Obtain films, videotapes, and other resources to supplement instruction of this unit. See "Resources Used in Developing This Unit" and "Suggested Supplemental Resources" for more information.
- Make transparencies or computer presentation from the transparency masters included in this unit. These appear in the teacher edition only and should be used with objectives as indicated below.

TM 1—Renewable Natural Resources (Objective 2)

TM 2—Nonrenewable Natural Resources (Objective 2)

TM 3—Basic Components of the Physical Environment (Objective 3)

TM 4—Types of Pollution (Objective 7)

TM 5—Solid Waste (Objective 12)

- Use the following teacher supplements to enhance your delivery and applications.

TS 1—Complete a Class Community Service Project

TS 2—Build and Use a Composting Site (Objective 15)

TS 3—Analyze Current Reports Concerning Natural Resources and Conservation Areas

- Use Student Supplement 1—The Hows and Whys of Compost with Objective 15.

Suggested Activities

- Select teacher components (written test, teacher supplements) you want to distribute to your students. Copy and prepare these components for distribution.
- Prepare classroom. Put up posters and charts and display articles and other references related to this unit.

Delivery and Application

- Discuss unit and specific objectives.
- Discuss information sheets. Implement teaching plan to localize, supplement, and personalize the unit. Reinforce basic academic and workplace skills when applicable.
- Discuss the assignment sheets and job sheets. Review with students the criteria for evaluation of these activities.

Teaching Suggestions

The skill areas appearing in bold-face type in the additional activities refer to the academic and workplace skills identified in *What Work Requires of Schools: A SCANS Report for America 2000* and *Workplace Basics: The Skills Employers Want*. These have been adapted by MAVCC.

- Prepare a representative sample of garbage from home making sure that there are no harmful objects such as broken glass or medication in the contents. Then have students separate the garbage and determine what percentage is paper, aluminum, food, plant material, plastic, metal, glass, and other. Discussion could be integrated with Assignment Sheet 1 — Identify Recycling Centers in Your Area. (**Problem solving; acquiring information; math; teamwork**)
- Have students read Student Supplement 1 — The Hows and Whys of Compost when discussing Objective 15. You may use Teacher Supplement 2 — Build and Use a Composting Site to encourage students to learn how composting can both protect and benefit the environment. (**Decision making; teamwork; leadership; listening; writing; utilizing resources**)
- Divide the class into groups according to recycled products to be researched when assigning Assignment Sheet 4 — Trace Route of Recyclable Products. Each group would be responsible for tracking the assigned product. (**Acquiring information; problem solving; teamwork**)

Suggested Activities

- Work with students to start a community service project. Using Teacher Supplement 1 — Complete a Class Community Service Project, let the students plan and organize the activities. (**Decision making; teamwork; leadership; listening; speaking; writing; utilizing resources**)
- Conduct a classroom discussion on natural resources in your area and local industries that use natural resources. Discussion could assist students while completing Assignment Sheet 1 — Report on a Current Event Affecting Natural Resources, and Assignment Sheet 2 — Report on a Local Natural Resource Problem. (**Listening; speaking**)
- Have students complete Assignment Sheet 1 — Report on a Current Event Affecting Natural Resources, to review a current event and how it affects natural resources. Be sure to set parameters for the oral presentation (minimum and maximum times) and allow a brief period after presentation for questions and/or discussion. (**Reading; science; oral communications; critical thinking**)
- Have students share the information they collected in Assignment Sheet 5 — Identify Occupations in Natural Resources in Your Area, concerning local businesses and industries involved with natural resources. Discuss career opportunities that were identified. (**Speaking; listening; career awareness**)
- Invite a guidance counselor to talk to students about the various careers in natural resources and education requirements. Give students an opportunity to ask questions about careers they are interested in. (**Listening; speaking; career awareness**)
- Encourage students who have excelled in this unit to complete Teacher Supplement 3 — Analyze Current Reports Concerning Natural Resources and Conservation Conflict Areas. This assignment would allow the student to explore the various factors and viewpoints involved in natural resources. (**Reading; science; critical thinking; acquiring information; writing**)

Evaluation

- Give and evaluate Natural Resources and Conservation Review.
- Copy written test and give to students as pretest.
- Evaluate assignment sheets. See the evaluation criteria listed at the top of each assignment sheet. Evaluation criteria may be localized, personalized, or individualized to fit your situation. Record student's grade in your grade book.

Suggested Activities

Instructions for Evaluating Student Performance

- Give and evaluate written test. Record student's written test score in your grade book and on the student's competency profile.
- Measure competency gains by comparing written pretest scores with posttest scores.
- Meet individually with students to evaluate their progress through this unit of instruction and indicate to them possible areas of improvement.
- Reteach and retest as required.
- When the student is ready to perform a specific task, obtain a copy of the assignment sheet which may be found in the student workbook.
- Once the student has completed an assignment sheet, evaluate the student's work using the evaluation criteria. If the student's work is unsatisfactory, have the student review the assignment and submit work for evaluation again. Record the appropriate level of competency on the student's competency profile.
- Sample performance evaluation keys have been provided below. Many other keys are available. Select one rating scale, which best fits your program needs.

Option A

4—**Skilled**—Can perform job with no additional training.

3—**Moderately skilled**—Has performed job during training program; limited additional training may be required.

2—**Limited skill**—Has performed job during training program; additional training is required to develop skill.

1—**Unskilled**—Is familiar with process, but is unable to perform job.

0—**No exposure**—No information or practice provided during training programs

Option B

Yes—Can perform job with no additional training.

No—Is unable to perform job satisfactorily.

- Encourage students to continue their portfolio. The portfolio should be a record of the student's progress in the study of natural resources.

Resources Used in Developing This Unit

Note: URLs change frequently. Any of the web sites listed below may have moved.

- *Applied Biology/Chemistry, 2nd Edition*. Waco, TX: Center for Occupational Research and Development. www.cord.org
- Camp, William G. and Thomas Daughtery, *Managing Our Natural Resources (4th Edition)*. Albany, NY: Delmar Publishers Inc., 2002. www.agriscience.delmar.com

Suggested Activities

Suggested Supplemental Resources

- *Earth's Threatened Resources: Tales of Earth, Sea, and Sky.* Washington, DC: Editorial Research Reports, Congressional Quarterly Books, 1986.
- Kircher, Harry B., D.L. Wallace, and D.J. Gore, *Our Natural Resources and their Conservation*, Danville, IL: The Interstate Printers & Publishers, Inc. 1992.
www.interstatepublishers.com
- *Teaching Tools Home* sponsored by Conoco/Phillips Petroleum Company. Provides educational videos and teaching guides. For more information: www.teachingtools.com
Biodiversity: Wild About Life—This four part docu-drama is about four teenagers who discover the variety of life on earth. From wolves to wetlands and deserts. (Co-produced by the U.S. Fish and Wildlife Training Center and The National Fish and Wildlife Foundation)
The Search for Solutions—This nine part series introduces young people to the fun of problem-solving and the excitement of hunting the elusive laws and facts of nature.
- *Where Does My Garbage Go?* — video available from free loan lending video library system, USDA Forestry Service. For more information: www.fs.fed.us
- USDA Natural Resources Conservation Service — publications and links. Contact: www.ncrs.usda.gov
- *21st Century Guide to Federal Job and Career Information — Labor Department Data on Future Jobs, Occupational Outlook Handbook, Government Jobs and Careers, Military Career Guides, Student Programs and Internships, Agency Career Information*, U.S. Government, Publisher Progressive Management, 2003. A comprehensive CD ROM using Adobe Acrobat PDF software provides a thorough guide to information about employment, jobs and the job market, and career opportunities in both the private and the federal government. Publication may be ordered from: www.amazon.com
- *Guide to America's Federal Jobs (2nd Edition)* — A Complete Directory of Federal Career Opportunities, Indianapolis, IN, Jist Works, 2003. Provides information on federal government jobs, what they are and how to get one. For more information: www.jist.com
- *Environmental Career Opportunities*, a web site that identifies current job vacancies in the United States in conservation and natural resource management. www.ecojobs.com
- *Natural Resources Duty/Task List*, Stillwater, OK, Oklahoma Department of Career and Technology Education, 2002.

Suggested Activities

- *Career Cluster Resources for Agriculture, Food, & Natural Resources*, National Association of State Directors of Career Technical Education Consortium, 2002. Provides career pathways and occupations for Natural Resource Systems and Environmental Service Systems. For more information: www.careerclusters.org

- *FFA Agricultural Proficiency Awards* —

Environmental Science and Natural Resources Management —

Typically results in FFA members receiving practical experiences concerned with the principles and practices of managing and/or improving the environment and natural resources. Activities may include management of agriculture waste, recycling of agriculture products, environmental cleanups, conservation corps, agricultural energy usage, multiple uses of resources, land use regulations including soil, water and air quality, preservation of wetlands, shorelines, and grasslands, wildlife surveys, erosion prevention practices, public relations, and education concerning pollution.

Home and/or Community Development — Typically involves improving and protecting beauty of an area by using natural vegetation or commercial ornamental plants and/or modernizing the home for better health and comfort through installation or improvement of water and sanitary facilities, heating and air conditioning or labor saving devices. Also includes community development activities such as volunteerism, community development and community betterment activities.

Outdoor Recreation — Typically strives to develop outdoor recreational activities as the primary land use. Some activities best suited to family use or as income-producing enterprises are vacation cabins and cottages, camping areas, fishing, hunting, shooting preserves, guide services, riding stables, vacation farms and guest ranches, natural scenic or historic areas, and rodeo events where member does not own or manage animals.

Wildlife Production and Management — Typically strives to improve the availability of fish and wildlife through practices such as land and water habitat improvement, development of new land and water habitat, trapping, Fish & Wildlife departments, Forest Service, Department of Natural Resources or the stocking of fish and wild game. Wildlife ducks, geese, quail and pheasants are eligible if used as an income enterprise.

For more information, contact the National FFA Organization at www.ffa.org

Suggested Lesson Plan

Day 1

Introduction:

- Interest approach—start class with a simulation. Ask them to imagine a world with limited clean water, no petroleum or gasoline and minimal topsoil. These problems could also contribute to animals becoming extinct and plant growth to decrease significantly. Discuss with students what impact this would have on our lives. Challenge the students to think of how actions taken today could create or prevent this scenario.
- Discuss unit objective and review specific objectives and plan for completing this unit.
- Have students read the introduction and discuss their viewpoints toward natural resources.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 2—Types of natural resources.
- Use TMs 1 and 2 to illustrate renewable and nonrenewable natural resources.
- Discuss Objective 3—Basic components of the physical environment.
- Use TM 3 to illustrate the basic components.
- Discuss Objective 4—History of natural resources.

Closure:

- Review discussion on introductory remarks.
- Review Objectives 2 and 3.

Evaluation:

- Non-applicable.

Day 2

Introduction:

- Review Objective 4.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 5—Importance of natural resources.
- Discuss Objective 6—Conflicts in natural resource management.
- Discuss Objective 7—Factors which affect natural resources.
- Use TM 4 to illustrate types of pollution.
- Discuss Objective 8—Preservation and conservation of natural resources.
- Assign Assignment Sheet 1—Report on a Current Event Affecting Natural Resources.
- Have students read introduction and discuss.
- Review directions for completing assignment sheet.
- Set dates for presentations (suggest Days 5 and 6).

Suggested Lesson Plan

Day 3

Closure:

- Review objectives 5, 6, and 7.

Evaluation:

- Non-applicable.

Introduction:

- Review objective 8.
- Review Assignment Sheet 1 directions.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 9—Preservation activities.
- Discuss Objective 10—Conservation activities.
- Provide supervised study for research on Assignment Sheet 1.

Closure:

- Review objectives 9 and 10.

Evaluation:

- Non-applicable.

Day 4

Introduction:

- Review progress on Assignment Sheet 1 and schedule presentations.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 11—Categories of solid waste.
- Discuss Objective 12—Composition of solid waste in a typical municipal landfill.
- Use TM 5 to illustrate solid waste.
- Provide supervised study for Assignment Sheet 1.

Closure:

- Review objectives 11 and 12.
- Review presentation schedule for Assignment Sheet 1.

Evaluation:

- Non-applicable.

Day 5

Introduction:

- Review progress on Assignment Sheet 1.
- State presentation schedule for Assignment Sheet 1 for today's class.

Delivery and Application:

- Have students present Assignment Sheet 1 report presentations. Maximum time for each presentation is five (5) minutes.
- Allow time for brief questions or discuss after each report.

Suggested Lesson Plan

Day 6

Closure:

- Review highlights of report presentations.
- Review presentation schedule for Assignment Sheet 1.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 1 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 1 grade in grade book.
- Record appropriate competency level on student's competency profile.

Introduction:

- State presentation schedule for Assignment Sheet 1 for today's class.

Delivery and Application:

- Have students present Assignment Sheet 1 report presentations. Maximum time for each presentation is five (5) minutes.
- Allow time for brief questions or discuss after each report.

Closure:

- Review highlights of report presentations.
- Review presentation schedule for Assignment Sheet 1.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 1 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 1 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Day 7

Introduction:

- State presentation schedule for Assignment Sheet 1 for today's class.
- State the objectives for today's lesson.

Delivery and Application:

- Have students present Assignment Sheet 1 report presentations. Maximum time for each presentation is five (5) minutes.
- Allow time for brief questions or discuss after each report.
- Assign Assignment Sheet 2 — Report on a Local Natural Resource Problem.
— Discuss introduction and directions.
- Allow supervised study for research after Assignment Sheet 1 presentations are completed.

Closure:

- Review highlights of report presentations.
- Discuss due date for Assignment Sheet 2 (suggest Day 10).

Suggested Lesson Plan

Day 8

Evaluation:

- Evaluate each student's performance on Assignment Sheet 1 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 1 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Introduction:

- Review progress on Assignment Sheet 2.
- Review objectives 11 and 12.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 13—Methods of waste disposal.
- Discuss Objective 14—Waste reduction activities.
- Discuss Objective 15—Recyclables and nonrecyclables.
- Have students read Student Supplement 1—The Hows and Whys of Compost. Discuss the use of compost.
- Allow time for supervised study on Assignment Sheet 2.

Closure:

- Review objectives 13 and 14.

Evaluation:

- Non-applicable.

Day 9

Introduction:

- Review progress on Assignment Sheet 2.
- Review objective 15 (see teaching suggestions—representative sample of garbage).
- State the objectives for today's lesson.

Delivery and Application:

- Assign Assignment Sheet 3—Identify Recycling Centers in your Area.
 - Review introduction.
 - Discuss directions.
- Assign Assignment Sheet 4—Trace Route of Recyclable Products. Review introduction.
 - Discuss directions.
 - Assign student(s) a recycled product to be researched.
- Provide for supervised study for Assignment Sheets 3 and 4 and completion of Assignment Sheet 2.

Closure:

- Discuss due date for Assignment Sheet 3 (suggest Day 11).
- Discuss due date for Assignment Sheet 4 (suggest Day 12).
- Turn in completed Assignment Sheet 2.

Suggested Lesson Plan

Day 10

Evaluation:

- Evaluate each student's performance on Assignment Sheet 2 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 2 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Introduction:

- Return student's Assignment Sheet 2. Briefly discuss highlights of reports.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 16—Federal agencies responsible for natural resources.
- Provide supervised study for Assignment Sheets 3 and 4.

Closure:

- Review objective 16.
- Review progress on Assignment Sheets 3 and 4.

Evaluation:

- Non-applicable.

Day 11

Introduction:

- Review progress on Assignment Sheets 3 and 4.
- State the objectives for today's lesson.

Delivery and Application:

- Provide supervised study for Assignment Sheets 3 and 4.

Closure:

- Review progress on Assignment Sheet 4.
- Turn in completed Assignment Sheet 3.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 3 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 3 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Day 12

Introduction:

- Return student's Assignment Sheet 3. Briefly discuss highlights.
- Review progress on Assignment 4.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 17—Types of occupations in natural resources.
- Discuss Objective 18—Getting a job in natural resources.
- Discuss Objective 19—Characteristics of a person working in natural resources.

Suggested Lesson Plan

Day 13

- Assign Assignment Sheet 5—Identify Occupations in Natural Resources in Your Area.
 - Review introduction.
 - Discuss directions.
- Provide supervised study for Assignment Sheet 5 and completion of Assignment 4.

Closure:

- Discuss due date for Assignment Sheet 5 (suggest Day 15).
- Turn in completed Assignment Sheet 4.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 4 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 4 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Introduction:

- Return student's Assignment Sheet 4. Briefly discuss highlights.
- Review progress on Assignment Sheet 5.
- Review for written test.
- State the objectives for today's lesson.

Delivery and Application:

- Have students complete Natural Resources and Conservation Review during class.
- Provide supervised study for Assignment Sheet 5 and written test.

Closure:

- Turn in completed review.
- Review terms and definitions.

Evaluation:

- Evaluate each student's performance on Natural Resources and Conservation Review according to answer key.
- Record student's unit review grade in grade book.

Day 14

Introduction:

- Return student's unit review. Discuss problem areas.
- Review for written test.
- State the objectives for today's lesson.

Delivery and Application:

- Give written test.
- Provide supervised study on Assignment Sheet 5 for students who have completed written test.

Closure:

- Review expectations for Assignment 5.

Suggested Lesson Plan

Day 15

Evaluation:

- Evaluate written test.
(Note: Develop teaching strategies for students who did not achieve the minimum score.)
- Record written test grade in grade book.
- Record written test score on each student's competency profile.

Introduction:

- Return student's written test and review answers.
- Discuss strategies for students who did not achieve the minimum score.
- Review objectives 17, 18, and 19.
- State the objectives for today's lesson.

Delivery and Application:

- Have students complete Assignment Sheet 5.

Closure:

- Turn in Assignment Sheet 5. (Turn back to students at next class.)
- Review unit objectives.
- Review next lesson.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 5 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 5 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Natural Resources and Conservation Review

Name _____ Overall Rating _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate serious effort was taken in completing worksheet	_____

Introduction

Natural resources are those items human use from their environment. Natural resources are important to us since we use them so frequently. Water, fuel, lumber, clothing, and food (plant and animal) are all natural resources we rely upon every day. Natural resources are not limitless and must be used wisely, recycled, or replaced.

Directions

Answer the following questions concerning natural resources and conservation. For help, refer to the information sheets and student supplement in this unit. Circle the correct response for each question.

1. Natural resources may be defined as:
 - a. Hydrogen compounds derived from the remains of organisms buried millions of years ago.
 - b. Land, water, air, wildlife, sunlight, and human labor.
 - c. A material that decomposes in the environment as a result of the activity of microorganisms.
 - d. Changes in the environment caused by some form of management.
2. An ecosystem:
 - a. Is a unit of the environment comprising the interaction of all organisms and the physical components within a given geographic area.
 - b. Involves the world.
 - c. Is the layer of the atmosphere that protects the earth from ultraviolet radiation in sunlight.
 - d. Transforms waste products into new products.
3. Harmful waste that contaminates the air, water, and soil and reduces the quality of the environment is a:
 - a. Protected species.
 - b. Hazardous (toxic) waste
 - c. Pollutant
 - d. Fossil fuel

Review

4. Renewable natural resources are:
 - a. Resources which cannot be replaced in a lifetime after they are used.
 - b. Formed by decaying vegetation (coal) and animal life (oil and gas).
 - c. Soil and other minerals such as sand, iron, lead, gold and aluminum.
 - d. Resources which can be replaced after they have been used.
5. As a basic component of the physical environment, air:
 - a. Is vital to plants and animals for respiration (oxygen/carbon dioxide exchange).
 - b. Is the basic source of all energy on earth.
 - c. Forms very slowly, may take thousands of years to produce enough to sustain vegetation.
 - d. Can be contaminated by sewage, industrial waste, runoff from unprotected soil, and municipal storm runoff.
6. Select a true statement concerning the history of natural resources.
 - a. With the increase in population, natural resources are still so abundant that there is no need to conserve them.
 - b. Management of natural resources is always a local issue.
 - c. As populations increase, natural resources tend to become scarce.
 - d. Humans have only used natural resources during the last century.
7. Using up the total quality of a resource is called:
 - a. Degradation.
 - b. Recycling.
 - c. Urbanization.
 - d. Depletion.
8. A reduction in the quality of the environment by the introduction of impurities is called:
 - a. Pollution.
 - b. Pollutant.
 - c. Environmental impact.
 - d. Degradation.

9. Conservation:
- a. Provides for the use and enjoyment of certain areas while leaving them unaltered for future generations.
 - b. Represents something that is there for the taking and for our own use, with little regard for other creatures in the ecosystem.
 - c. Transforms waste products into new products.
 - d. Promotes the use of natural resources in a manner, which minimizes waste, encourages renewal, and maintains that resource for future use.
10. _____ is a preservation activity.
- a. Protect native animals and plants.
 - b. Use fertilizers conservatively to prevent groundwater contamination.
 - c. Plant trees. These use carbon dioxide and produce oxygen.
 - d. Use products that are recycled, recyclable, repairable, refillable, reusable, and long-lasting.
11. Solid waste from raising, slaughtering, and processing animal products and from orchards and field crops is _____ category of solid waste.
- a. Pesticide
 - b. Commercial
 - c. Institutional
 - d. Agricultural
12. _____ is the largest percentage of solid waste in a typical municipal landfill.
- a. Yard wastes.
 - b. Paper and paperboard.
 - c. Plastics.
 - d. Food wastes.
13. About _____ of trash goes to landfills.
- a. 80%.
 - b. 41%.
 - c. 50%.
 - d. 10%.

Review

14. About _____ of trash is incinerated (with or without energy recovery).
 - a. 80%.
 - b. 50%.
 - c. 25%.
 - d. 10%.
15. About _____ of trash is recycled.
 - a. 80%.
 - b. 50%.
 - c. 25%.
 - d. 10%.
16. The challenge of making recycling economically feasible is to:
 - a. Improve technology for collecting and processing recyclables.
 - b. Collect recyclable materials from individuals, businesses, and industries.
 - c. Have a stable market for recycled products where supply equals demand.
 - d. Separate recyclable products before they can be recycled.
17. Eliminating waste before it happens is what type of waste reduction activity?
 - a. Careful buying.
 - b. Waste avoidance.
 - c. Source reduction.
 - d. Recycling.
18. _____ is recyclable.
 - a. Waste heavily contaminated with food residue.
 - b. Furniture.
 - c. Compost.
 - d. Composite materials.
19. _____ federal agency helps prevent soil erosion from wind and water by working with local soil and water conservation districts and assisting in individual conservation plans and other conservation measures.
 - a. U.S. Geologic Survey.
 - b. Natural Resources Conservation Service.
 - c. National Park Service.
 - d. Bureau of Land Management.

Review

20. _____ federal agency determines environmental standards and enforces federal environment laws.
- a. Department of Energy.
 - b. U.S. Army Corps of Engineers.
 - c. Department of Defense.
 - d. Environmental Protection Agency.
21. The U.S. Fish and Wildlife Service:
- a. Works to manage and protect forestland and grassland while promoting their best use.
 - b. Helps protect the nation's birds, mammals, fish, and other wildlife.
 - c. Works to develop water, land, energy resources, and other natural resources in the western United States.
 - d. Manages federal grasslands, prairie, desert, forest, and other open spaces of the nation's public lands.
22. _____ is an occupation that manages natural resources.
- a. Ecologist.
 - b. Trucker.
 - c. Ranger.
 - d. Teacher.
23. A farmer works in an occupation that:
- a. Manages natural resources.
 - b. Collects and harvests natural resources.
 - c. Converts natural resources to energy.
 - d. Disposes of waste.
24. _____ is a characteristic of a person working in natural resources.
- a. Desires to work indoors.
 - b. Desires to work in heavy industry.
 - c. Likes to interact with the natural environment.
 - d. Dislikes people.

Natural Resources and Conservation Review—Answer Key

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate serious effort was taken in completing worksheet	_____

1. Natural resources may be defined as:
 - a. Hydrogen compounds derived from the remains of organisms buried millions of years ago.
 - b. Land, water, air, wildlife, sunlight, and human labor.**
 - c. A material that decomposes in the environment as a result of the activity of microorganisms.
 - d. Changes in the environment caused by some form of management.
2. An ecosystem:
 - a. Is a unit of the environment comprising the interaction of all organisms and the physical components within a given geographic area.**
 - b. Involves the world.
 - c. Is the layer of the atmosphere that protects the earth from ultraviolet radiation in sunlight.
 - d. Transforms waste products into new products.
3. Harmful waste that contaminates the air, water, and soil and reduces the quality of the environment is a:
 - a. Protected species.
 - b. Hazardous (toxic) waste
 - c. Pollutant**
 - d. Fossil fuel

Review—Answer Key

4. Renewable natural resources are:
 - a. Resources which cannot be replaced in a lifetime after they are used.
 - b. Formed by decaying vegetation (coal) and animal life (oil and gas).
 - c. Soil and other minerals such as sand, iron, lead, gold and aluminum.
 - d. **Resources which can be replaced after they have been used.**
5. As a basic component of the physical environment, air:
 - a. **Is vital to plants and animals for respiration (oxygen/carbon dioxide exchange).**
 - b. Is the basic source of all energy on earth.
 - c. Forms very slowly, may take thousands of years to produce enough to sustain vegetation.
 - d. Can be contaminated by sewage, industrial waste, runoff from unprotected soil, and municipal storm runoff.
6. Select a true statement concerning the history of natural resources.
 - a. With the increase in population, natural resources are still so abundant that there is no need to conserve them.
 - b. Management of natural resources is always a local issue.
 - c. **As populations increase, natural resources tend to become scarce.**
 - d. Humans have only used natural resources during the last century.
7. Using up the total quality of a resource is called:
 - a. Degradation.
 - b. Recycling.
 - c. Urbanization.
 - d. **Depletion.**
8. A reduction in the quality of the environment by the introduction of impurities is called:
 - a. **Pollution.**
 - b. Pollutant.
 - c. Environmental impact.
 - d. Degradation.

Review—Answer Key

9. Conservation:
- a. Provides for the use and enjoyment of certain areas while leaving them unaltered for future generations.
 - b. Represents something that is there for the taking and for our own use, with little regard for other creatures in the ecosystem.
 - c. Transforms waste products into new products.
 - d. **Promotes the use of natural resources in a manner, which minimizes waste, encourages renewal, and maintains that resource for future use.**
10. _____ is a preservation activity.
- a. **Protect native animals and plants.**
 - b. Use fertilizers conservatively to prevent groundwater contamination.
 - c. Plant trees. These use carbon dioxide and produce oxygen.
 - d. Use products that are recycled, recyclable, repairable, refillable, reusable, and long-lasting.
11. Solid waste from raising, slaughtering, and processing animal products and from orchards and field crops is _____ category of solid waste.
- a. Pesticide
 - b. Commercial
 - c. Institutional
 - d. **Agricultural**
12. _____ is the largest percentage of solid waste in a typical municipal landfill.
- a. Yard wastes.
 - b. **Paper and paperboard.**
 - c. Plastics.
 - d. Food wastes.
13. About _____ of trash goes to landfills.
- a. **80%.**
 - b. 41%.
 - c. 50%.
 - d. 10%.

Review—Answer Key

14. About _____ of trash is incinerated (with or without energy recovery).
- a. 80%.
 - b. 50%.
 - c. 25%.
 - d. **10%.**
15. About _____ of trash is recycled.
- a. 80%.
 - b. 50%.
 - c. 25%.
 - d. **10%.**
16. The challenge of making recycling economically feasible is to:
- a. Improve technology for collecting and processing recyclables.
 - b. Collect recyclable materials from individuals, businesses, and industries.
 - c. **Have a stable market for recycled products where supply equals demand.**
 - d. Separate recyclable products before they can be recycled.
17. Eliminating waste before it happens is what type of waste reduction activity?
- a. Careful buying.
 - b. Waste avoidance.
 - c. **Source reduction.**
 - d. Recycling.
18. _____ is recyclable.
- a. Waste heavily contaminated with food residue.
 - b. Furniture.
 - c. **Compost.**
 - d. Composite materials.
19. _____ federal agency helps prevent soil erosion from wind and water by working with local soil and water conservation districts and assisting in individual conservation plans and other conservation measures.
- a. U.S. Geologic Survey.
 - b. **Natural Resources Conservation Service.**
 - c. National Park Service.
 - d. Bureau of Land Management.

Review—Answer Key

20. _____ federal agency determines environmental standards and enforces federal environment laws.
- a. Department of Energy.
 - b. U.S. Army Corps of Engineers.
 - c. Department of Defense.
 - d. **Environmental Protection Agency.**
21. The U.S. Fish and Wildlife Service:
- a. Works to manage and protect forestland and grassland while promoting their best use.
 - b. **Helps protect the nation's birds, mammals, fish, and other wildlife.**
 - c. Works to develop water, land, energy resources, and other natural resources in the western United States.
 - d. Manages federal grasslands, prairie, desert, forest, and other open spaces of the nation's public lands.
22. _____ is an occupation that manages natural resources.
- a. **Ecologist.**
 - b. Trucker.
 - c. Ranger.
 - d. Teacher.
23. A farmer works in an occupation that:
- a. Manages natural resources.
 - b. **Collects and harvests natural resources.**
 - c. Converts natural resources to energy.
 - d. Disposes of waste.
24. _____ is a characteristic of a person working in natural resources.
- a. Desires to work indoors.
 - b. Desires to work in heavy industry.
 - c. **Likes to interact with the natural environment.**
 - d. Dislikes people.

Answers to Assignment Sheets**Assignment
Sheet 1****Report on a Current Event Affecting Natural Resources**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 2****Report on a Local Natural Resource Problem**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 3****Identify Recycling Centers in Your Area**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 4****Trace Route of Recyclable Products**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 5****Identify Occupations in Natural Resources in Your Area**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Teacher Supplement 1—Complete a Class
Community Service Project****Introduction**

Throughout this unit the importance of natural resources and conservation has been emphasized. A number of subjects have been covered, from recycling and conservation actions, to identifying local pollution sources and problems. In this exercise you will be asked to work with your classmates to put your knowledge to action in a community service project which will positively affect the natural resources and environment of your community.

Directions

With your instructor serving as the meeting chairperson, as a class select and agree upon a project selected from the accompanying list, or one uniquely specific to your community, which will conserve or enhance natural resources or the community environment.

- A project similar to the clean up efforts in some states called "Adopt a Highway," in which a group agrees to remove litter from a specific amount of road or street right-of-way.
- A yard waste collection effort (which might feed the composting project found in Teacher Supplement 2)
- A task force to collect used motor oil, or old, partially consumed paint cans, and discarded pesticide containers, aerosol bombs, etc. for proper disposal.
- A fund-raising event to help the needy insulate their homes for more efficient heating and cooling.
- A work project in which class members actually provide the labor and donated materials to weatherize homes of the elderly and needy for improved energy use in winter.
- A tree-planting project in community parks or other city and county landscapes. (Most states have forestry-department-related nurseries from which low-cost seedling trees adapted to specific uses may be obtained).
- A task force to collect discarded tires from the community for proper disposal. (Tires can be recycled, and those that remain in the environment many times hold puddles of rainwater which provide breeding places for mosquitoes).
- A composting project to turn local waste into useable mulch.

Teacher Supplement 1

- An information campaign carried out through newspaper, radio and television interviews, point of-purchase literature (at home improvement stores) to urge homeowners to seek an energy audit by local utility companies. (Work with local utility companies to obtain information and tips on community contacts).
- A class contest to research and build solar collectors from waste materials such as aluminum cans, scrap tempered glass, etc.
- A Christmas tree collection project used to accumulate trees after the holidays for use as fish habitat in local lakes and ponds, or for use as mulch. (Work with local wildlife department employees on pond structures for fish. Many cities have equipment to grind such trees into useable mulch and compost).
- A class cleanup of local stream and river banks.
- Work with local Natural Resources Conservation Service personnel, or wildlife department employees in planting wildlife food and cover plots.
- Build and sell bird houses and bird feeders to community residents. (Plans are available from most state wildlife conservation departments, or through land-grant university Cooperative Extension offices).
- Work with local park officials to identify and label the different species of trees, grasses, and shrubs in parks and other public use areas.
- Work with city officials in planting flowers, shrubs, and other landscape species in city beautification projects.
- Conduct a "paper drive" in which old newspapers are collected for recycling.
- Plant windbreaks and wildlife habitat crops on school property to control snow drifting, hot winds, and to provide for increased game and non-game species near your school. (Work with wildlife department officials and forestry or Natural Resources Conservation Service personnel).

Once your class has selected a community service project and, with the help of your instructor, assign various duties to class members to accomplish. Keep records, take pictures, and collect news articles concerning your project. Write a report explaining the importance of the project to your community, using the information you have collected.

**Teacher Supplement 2—Build and Use
a Composting Site****Introduction**

Throughout this unit the importance of recycling and wise use of natural resources has been emphasized. Composting was listed as one of the ways material many call waste can be used to enhance the productivity of the soil at the same time it limits the amount of material stored in landfills. Using the information in Student Supplement 1A and other materials readily available at your school or community library, the class will build and operate a composting site to learn how composting can both protect and benefit the environment.

Directions

Before beginning this activity, your instructor will divide the class into groups assigned the following specific tasks:

1. Secure a dependable supply of compostable material such as yard clippings and garden waste; cafeteria and kitchen wastes; a limited amount of old newspapers, etc. Seek this material from lawn enthusiasts, restaurants, and the school cafeteria.
2. Secure a dependable supply of materials high in nitrogen such as animal or poultry manures, relatively fresh green leafy plant material, dried blood (from packing houses) or any other waste products high in nitrogen. (Do not use meat products or waste!) Seek these materials from the school agricultural education classes, local horse or poultry farms, zoos, dairies, animal feeding areas, or meat packing plants.
3. Secure the necessary materials to build an easy-to-use inexpensive compost bin. This can be reinforcing mesh wire, concrete blocks, landscape timbers, old railroad cross ties, or anything else that will contain a compost pile while it works for the community. (Use your imagination. The less expensive the material, the better the project!)
4. Secure a "market" for the finished compost such as garden club members, school landscape crews, city parks and recreation crews, or local truck farmers, and greenhouse owners.
5. Select one member from each team to serve on a special committee to promote this project as a community service, emphasizing the dual benefits of reducing wastes and creating a needed product. This committee should seek attention from school and community newspapers and radio and television stations.

Teacher Supplement 2

Equipment, and Materials

- Items listed in 1-3 on the previous page and Student Supplement 1.
- Other creative materials

Procedure

- ☐ 1. Select a site suitable for recycling wastes in a compost operation. Use ideas from Student Supplement 1A, material gathered from gardening books, and pamphlets from your state's land-grant university Cooperative Extension service.
- ☐ 2. Assemble the necessary materials to make at least three bins or containment areas to hold the following:
 - Compostable material collected by the collection committee
 - An active compost pile
 - Finished product bound for the "market"
- ☐ 3. Store compostable material in constructed bin and build an active compost pile.
- ☐ 4. Work in teams of two, as assigned, to monitor the compost pile's inner temperature, and add material and stir as necessary. Record daily temperatures to track the biological activity inside the pile as noted in Student Supplement 1A.
- ☐ 5. Remove the cooled material from the active bin (once it shows no new signs of heating again) and store it until it can be used. As the active bin becomes available, start the process again, moving the composting materials in and out of the composting site.

Note: Regardless of the weather, as long as the compost pile is layered properly and contains the correct amount of nitrogenous materials (greens and manures) and high carbon materials (dried plant materials) along with the proper water content, it will heat and produce compost. In extreme winter weather, cover the pile with a plastic tarp to maintain composting temperatures and bacterial activity.

- ☐ 6. Write a report on the project, detailing how it was organized, where the materials were secured, how the class worked as a team to produce a useable product from what otherwise would have been thrown away, and "success" stories from those who received the finished product—how they used the material and the results they have had or expect to have. Cite examples of how working with the school and community newspapers and broadcast outlets helped make the project a success.

Teacher Supplement 3—Analyze Current Reports Concerning Natural Resources and Conservation Conflict Areas

Evaluation Criteria	Rating
• Directions have been followed	_____
• Minimum of five current articles collected	_____
• Content is relevant and well organized	_____
• Report is neat and legible	_____

Introduction

As part of your ongoing study of current events as they relate to this unit of instruction, this assignment will allow you to explore the various factions and viewpoints involved in natural resources and their use.

Directions

From publications in your school and community library and local, state, and national newspapers, you are to collect a minimum of five current (within the past two years) articles dealing with areas of conflict (outlined in Objective 6 of this unit).

Summarize each of these articles, and write a report in which you analyze the content of the articles, emphasizing the need to protect the environment and natural resources with the economic aspects and constitutionally protected rights of private property owners.

Your instructor will provide you with guidelines explaining the format of the finished report. This assignment will be collected and retained in a portfolio that will become a record of the progress you have made in your study of natural resources.

Note: For help in finding recent periodicals concerning outdoor safety and natural resources, consult the *Reader's Guide* in your school or community library.

Written Test

Name _____

Date _____ Score _____

Objective 1

Match the terms related to natural resources and conservation with their definitions. Write the corresponding numbers on the blanks provided. Definitions continue on the next page.

- | | | |
|------------------|-----------------------|-----------------------|
| 1. Biodegradable | 7. Environmental | 12. Ozone layer |
| 2. Degradable | impact | 13. Pollutant |
| 3. Depletion | 8. Fossil fuels | 14. Pollution |
| 4. Ecosystem | 9. Global | 15. Protected species |
| 5. Ecologist | 10. Hazardous (toxic) | 16. Recycling |
| 6. Endangered | waste | 17. Urbanization |
| species | 11. Natural resources | 18. Waste |

- _____ a. Land, water, air, wildlife, sunlight, and human labor
- _____ b. A material that decomposes in the environment as a result of the activity of microorganisms
- _____ c. Waste material that poses a threat to human health
- _____ d. Lowering quality of a resource
- _____ e. Involving the world
- _____ f. Using up the total quantity of a resource
- _____ g. Hydrocarbon compounds derived from the remains of organisms buried millions of years ago
- _____ h. A unit of the environment comprising the interaction of all organisms and the physical components within a given geographic area
- _____ i. Changes in the environment caused by some form of management
- _____ j. One who studies the relationship between organisms and their environment
- _____ k. A species in immediate danger of becoming extinct

Written Test

	_____ l. Useless, unwanted, or discarded material _____ m. Layer of the atmosphere that protects the earth from ultraviolet radiation in sunlight _____ n. Growth or expansion of cities _____ o. A reduction in the quality of the environment by the introduction of impurities _____ p. Transforming waste products into new products _____ q. Waste material that poses a threat to human health.
Objective 2	Explain the difference between renewable and nonrenewable natural resources. _____ _____
Objective 3	Name four basic components of the physical environment. a. _____ b. _____ c. _____ d. _____
Objective 4	Select true statements concerning the history of natural resources by placing an "X" in the blanks next to the true statements. _____ a. Humans have always conserved natural resources. _____ b. Originally, resources were so abundant that there was no need to conserve them. _____ c. With the increase in population, some natural resources have become scarce.
Objective 5	Explain the importance of natural resources: _____ _____ _____

Written Test

Objective 6

Give four examples of conflicts in natural resource management.

- a. _____

- b. _____

- c. _____

- d. _____

Objective 7

List four factors which affect natural resources.

- a. _____
- b. _____
- c. _____
- d. _____

Objective 8

Distinguish between preservation and conservation of natural resources by placing an "X" next to the definition of preservation.

- _____ a. Promotes the use of natural resources in a manner which minimizes waste and maintains that resource for future use
- _____ b. Provides for the use of enjoyment of wilderness areas while leaving them unaltered for future generations

Objective 9

List five preservation activities.

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____

Written Test

Objective 10

List two activities to conserve each of the following natural resources.

a. Air conservation

- _____
- _____

b. Water conservation

- _____
- _____

c. Soil conservation

- _____
- _____

d. Energy conservation

- _____
- _____

Written Test

Objective 11

Match categories of solid waste with the descriptions. Write the corresponding numbers on the blanks provided.

- | | | |
|-----------------|------------------|----------------|
| 1. Agricultural | 3. Industrial | 5. Pesticide |
| 2. Commercial | 4. Institutional | 6. Residential |

- _____ a. Waste from stores, offices, and other activities that do not actually turn out a product
- _____ b. Waste that usually originates in homes
- _____ c. Waste from educational, health care, and research facilities
- _____ d. Solid waste from raising, slaughtering, and processing animal products and from orchards and field crops
- _____ e. Residue from the manufacturing, handling, and use of chemicals designed to kill plant and animal pests
- _____ f. Waste from industrial processes and manufacturing

Objective 12

Select true statements concerning the composition of solid waste in a typical municipal landfill by placing an "X" in the blanks next to the true statements.

- _____ a. The largest percentage of products in the municipal landfill is food waste.
- _____ b. Yard waste make up the majority of items in a landfill.
- _____ c. Glass makes up a small portion of items in a landfill.
- _____ d. Paper products make up nearly half of the contents of a landfill.

Objective 13

Complete the following statements concerning methods of waste disposal. Write the correct number on the blank provided for each item.

- _____ a. About _____ of trash goes to landfills.
 - 1) 10%
 - 2) 50%
 - 3) 80%
- _____ b. Fewer landfills are being built because _____.
 - 1) communities are running out of land for landfills
 - 2) community groups oppose the landfill sites
 - 3) landfills are no longer needed
- _____ c. Improperly sited and maintained landfills contaminate _____.
 - 1) air
 - 2) wildlife
 - 3) water

Written Test

- _____ d. Faulty incinerators create _____ pollution and toxic ash by-products.
- 1) air
 - 2) water
 - 3) land
- _____ e. The advantage of incinerators is that they reduce the volume of refuse by _____.
- 1) 30%
 - 2) 60%
 - 3) 90%
- _____ f. About _____ of trash is recycled.
- 1) 10%
 - 2) 50%
 - 3) 80%

Objective 14

Select true statements concerning waste reduction activities by placing an "X" in the blanks next to the true statements.

- _____ a. Source reduction is eliminating waste before it happens.
- _____ b. Recycling helps to reduce waste.
- _____ c. Making goods more durable does little to reduce waste since they will be discarded sooner or later.
- _____ d. A great deal of our waste can be recycled into new products.

Objective 15

Distinguish between recyclables and nonrecyclables by placing an "X" in the blanks next to the recyclables.

- _____ a. Glass
- _____ b. Aluminum
- _____ c. Leaves, grass
- _____ d. Waste heavily contaminated with food residue
- _____ e. Plastics
- _____ f. Wood
- _____ g. Paper
- _____ h. Composite materials
- _____ i. Furniture
- _____ j. Street sweepings

Objective 16

Match federal agencies responsible for natural resources with their descriptions. Write the corresponding numbers on the blanks provided.

- | | |
|--|--|
| 1. Agricultural Stabilization and Conservation Service | 9. Fish and Wildlife Service |
| 2. Bureau of Indian Affairs | 10. Forest Service |
| 3. Bureau of Land Management | 11. National Park Service |
| 4. Bureau of Mines | 12. Natural Resources Conservation Service |
| 5. Bureau of Reclamation | 13. U.S. Army Corps of Engineers |
| 6. Department of Defense | 14. U.S. Geologic Survey |
| 7. Department of Energy | |
| 8. Environmental Protection Agency | |

- _____ a. Manage federal grasslands prairie desert, forest, and other open spaces of the nation's public lands
- _____ b. Works to promote the welfare of the nation's Native Americans and their lands
- _____ c. Works to develop water, land, energy resources, and other natural resources in the western United States
- _____ d. Responsible for environmental impact of nation's network of military bases
- _____ e. Administers programs with funding for agricultural conservation activities and administers farm programs
- _____ f. Works to ensure efficient mining, processing, use, and recycling of mineral resources
- _____ g. Helps protect the nation's birds, mammals, fish, and other wildlife
- _____ h. Works to manage and protect forestland and grassland while promoting their best use
- _____ i. Conducts surveys of the land and its resources and develops maps based on these surveys
- _____ j. Determines environmental standards and enforces federal environmental laws
- _____ k. Responsible for environmental integrity of federal lands along navigable public waterways
- _____ l. Helps prevent soil erosion from wind and water
- _____ m. Manages more than 300 areas within the national parks system

Written Test

Objective 17

List five types of occupations in natural resources.

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____

Objective 18

List three ways of getting a job in natural resources.

- a. _____
- b. _____
- c. _____

Objective 19

List three characteristics of a person working in natural resources.

- a. _____
- b. _____
- c. _____

*Permission to duplicate this test is granted.

Written Test—Answer Key

Objective 1

Match the terms related to natural resources and conservation with their definitions. Write the corresponding numbers on the blanks provided. Definitions continue on the next page.

- | | | |
|-----------------------|-----------------------------|-----------------------|
| 1. Biodegradable | 7. Environmental impact | 12. Ozone layer |
| 2. Degradable | 8. Fossil fuels | 13. Pollutant |
| 3. Depletion | 9. Global | 14. Pollution |
| 4. Ecosystem | 10. Hazardous (toxic) waste | 15. Protected species |
| 5. Ecologist | 11. Natural resources | 16. Recycling |
| 6. Endangered species | | 17. Urbanization |
| | | 18. Waste |

- 11 a. Land, water, air, wildlife, sunlight, and human labor
- 1 b. A material that decomposes in the environment as a result of the activity of microorganisms
- 10 c. Waste material that poses a threat to human health
- 2 d. Lowering quality of a resource
- 9 e. Involving the world
- 3 f. Using up the total quantity of a resource
- 8 g. Hydrocarbon compounds derived from the remains of organisms buried millions of years ago
- 4 h. A unit of the environment comprising the interaction of all organisms and the physical components within a given geographic area
- 7 i. Changes in the environment caused by some form of management
- 5 j. One who studies the relationship between organisms and their environment
- 6 k. A species in immediate danger of becoming extinct

Written Test—Answer Key

	<u>18</u> l. Useless, unwanted, or discarded material <u>12</u> m. Layer of the atmosphere that protects the earth from ultraviolet radiation in sunlight <u>17</u> n. Growth or expansion of cities <u>14</u> o. A reduction in the quality of the environment by the introduction of impurities <u>16</u> p. Transforming waste products into new products <u>13</u> q. Waste material that poses a threat to human health.
Objective 2	Explain the difference between renewable and nonrenewable natural resources. Renewable resources can be replaced after they have been used, but nonrenewable resources cannot be replaced in a lifetime after they are used.
Objective 3	Name four basic components of the physical environment. (Any order) a. Air b. Water c. Soil d. Sunlight
Objective 4	Select true statements concerning the history of natural resources by placing an "X" in the blanks next to the true statements. <u> </u> a. Humans have always conserved natural resources. <u> X </u> b. Originally, resources were so abundant that there was no need to conserve them. <u> X </u> c. With the increase in population, some natural resources have become scarce.
Objective 5	Explain the importance of natural resources. <u>Answer may be in student's own words, but should include the fact that natural resources are needed for our survival</u> _____ _____

Written Test—Answer Key

Objective 6	Give four examples of conflicts in natural resource management. Any four of the following: • Wetlands needed by wildlife are drained and used for crop production • Agricultural land needed for food production is paved in urban development • Publicly owned forests needed for recreation are harvested for timber • Publicly owned forests needed for lumber (and the jobs involved in the timber industry) are placed off limits for harvest by recreation and preservation interests • Hunting is resisted by animal rights activists • Many development and agricultural activities destroy wildlife habitat • Swamps supporting a diversity of plants and animals are drained for urban and suburban development • Recreational uses of rural land can disrupt wildlife, and damage vegetation and landscapes • Fossil-fuel-fired electrical generation plants pollute the air of people who use electricity • Nuclear-powered electrical generation plants maintain clean air, but produce highly toxic waste products which must be stored and protected • Agricultural chemicals aid in producing abundant food supplies, but can adversely affect surface and ground water • Vehicles needed to transport people to their work places increase air pollution
Objective 7	List four factors which affect natural resources. Any four of the following: • Natural occurrences • Air, water, and land pollution from various sources • Urbanization • Agricultural practices • Mining practices • Drilling practices that may result in contamination of resources
Objective 8	Distinguish between preservation and conservation of natural resources by placing an "X" next to the definition of preservation. _____ a. Promotes the use of natural resources in a manner which minimizes waste and maintains that resource for future use <u> X </u> b. Provides for the use of enjoyment of wilderness areas while leaving them unaltered for future generations
Objective 9	List five preservation activities. Any five of the following: • Protect native animals and plants • Protect migration routes and preserve suitable areas for migratory animals • Manage harvested species through the use of fish and hunting regulation • Identify and protect endangered species and the ecosystems on which they depend • Protect natural landscapes • Restore and replant land areas altered by human activity • Prevent wetland drainage for domestic or industrial use • Manage fires either by extinguishing or by allowing them to burn themselves out if they benefit the ecological plan of the area • Manage surface and ground water by controlling erosion and preventing pollution • Manage air quality to protect human health, vegetation, visibility, wildlife, and fish • Manage soils to prevent soil erosion, physical removal, or contamination by waste disposal

Written Test—Answer Key

Objective 10

List two activities to conserve each of the following natural resources.

Any two of the following:

a. Air conservation

- Since cars are major air polluters, keep your car tuned up, change fuel filters often, maintain emission control devices, and use unleaded gasoline
- Drive less, ride more. Use mass-transit, carpools, bicycles, or walk to work
- Avoid using toxic chemicals released into the air such as oven cleaners and window cleaners. Instead use soap and water, baking soda, or vinegar.
- Protect the environment from chlorofluorocarbons (CFCs) which deplete the ozone layer. Check your automobile for air-conditioning leaks which can release CFCs.
- Plant trees. These use carbon dioxide and produce oxygen. Trees also help to purify the air, moderate temperatures, and absorb noise.

b. Water conservation

- Use low-flow shower heads. Short showers also use less water than baths.
- Use faucet aerators for each sink.
- Run washing machines and dishwashers only when they are full.
- Do not let faucets run while hand-washing dishes, brushing teeth, or shaving.
- Water plants and lawns only as needed, and only in the morning to reduce evaporation.
- Use fertilizers and pesticides conservatively to prevent ground water contamination.
- Fix leaky faucets and toilets.

c. Soil conservation

- Keep soil covered with grass, ground covers, trees, and plants to prevent erosion.
- Use recommended conservation practices such as crop rotation, contouring, and terracing to protect the soil's fertility and to prevent erosion.
- Do not send toxic substances such as oil, pesticides, or batteries to the municipal landfill.

d. Energy conservation

- Seal leaks and cracks around doors and windows with caulking and weather stripping.
- Increase the insulation in your home to the maximum recommendation.
- Drive fuel-efficient vehicles.
- Use mass-transit, carpools, bicycles, or walk.
- Set hot water heater at 120° F instead of 140° F.
- Use a cooler wash and cooler rinse in washing machines
- Turn down the heater at night.
- Use fluorescent lights instead of incandescent.
- Turn lights and TV off when not using them.
- Check for leaks around the refrigerator door. also check the temperature. Set at 38-42°F.
- Use high-efficiency appliances and those with energy-saving features.
- Use microwave ovens and pressure cookers because they use less energy, and save time too.
- Use alternative energies (solar, wind) where possible to lessen demand on nonrenewable energies (fossil fuels).
- Use products that are recyclable, repairable, refillable, reusable, and long-lasting.

BEST COPY AVAILABLE

Written Test—Answer Key

Objective 11

Match categories of solid waste with the descriptions. Write the corresponding numbers on the blanks provided.

- | | | |
|-----------------|------------------|----------------|
| 1. Agricultural | 3. Industrial | 5. Pesticide |
| 2. Commercial | 4. Institutional | 6. Residential |

- 2 a. Waste from stores, offices, and other activities that do not actually turn out a product
- 6 b. Waste that usually originates in homes
- 4 c. Waste from educational, health care, and research facilities
- 1 d. Solid waste from raising, slaughtering, and processing animal products and from orchards and field crops
- 5 e. Residue from the manufacturing, handling, and use of chemicals designed to kill plant and animal pests
- 3 f. Waste from industrial processes and manufacturing

Objective 12

Select true statements concerning the composition of solid waste in a typical municipal landfill by placing an "X" in the blanks next to the true statements.

- ☐ a. The largest percentage of products in the municipal landfill is food waste.
- ☐ b. Yard waste make up the majority of items in a landfill.
- ☒ c. Glass makes up a small portion of items in a landfill.
- ☒ d. Paper products make up nearly half of the contents of a landfill.

Objective 13

Complete the following statements concerning methods of waste disposal. Write the correct number on the blank provided for each item.

- 3 a. About _____ of trash goes to landfills.
 - 1) 10%
 - 2) 50%
 - 3) 80%
- 2 b. Fewer landfills are being built because _____.
 - 1) communities are running out of land for landfills
 - 2) community groups oppose the landfill sites
 - 3) landfills are no longer needed
- 3 c. Improperly sited and maintained landfills contaminate _____.
 - 1) air
 - 2) wildlife
 - 3) water

Written Test—Answer Key

	<u> 1 </u> d. Faulty incinerators create _____ pollution and toxic ash by-products. 1) air 2) water 3) land <u> 3 </u> e. The advantage of incinerators is that they reduce the volume of refuse by _____. 1) 30% 2) 60% 3) 90% <u> 1 </u> f. About _____ of trash is recycled. 1) 10% 2) 50% 3) 80%
Objective 14	Select true statements concerning waste reduction activities by placing an "X" in the blanks next to the true statements. <u> X </u> a. Source reduction is eliminating waste before it happens. <u> X </u> b. Recycling helps to reduce waste. _____ c. Making goods more durable does little to reduce waste since they will be discarded sooner or later. <u> X </u> d. A great deal of our waste can be recycled into new products.
Objective 15	Distinguish between recyclables and nonrecyclables by placing an "X" in the blanks next to the recyclables. <u> X </u> a. Glass <u> X </u> b. Aluminum <u> X </u> c. Leaves, grass _____ d. Waste heavily contaminated with food residue <u> X </u> e. Plastics <u> X </u> f. Wood <u> X </u> g. Paper _____ h. Composite materials _____ i. Furniture _____ j. Street sweepings

Written Test—Answer Key

Objective 16

Match federal agencies responsible for natural resources with their descriptions. Write the corresponding numbers on the blanks provided.

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Agricultural Stabilization and Conservation Service 2. Bureau of Indian Affairs 3. Bureau of Land Management 4. Bureau of Mines 5. Bureau of Reclamation 6. Department of Defense 7. Department of Energy 8. Environmental Protection Agency | <ol style="list-style-type: none"> 9. Fish and Wildlife Service 10. Forest Service 11. National Park Service 12. Natural Resources Conservation Service 13. U.S. Army Corps of Engineers 14. U.S. Geologic Survey |
|--|---|

- 3 a. Manage federal grasslands prairie desert, forest, and other open spaces of the nation's public lands
- 2 b. Works to promote the welfare of the nation's Native Americans and their lands
- 5 c. Works to develop water, land, energy resources, and other natural resources in the western United States
- 6 d. Responsible for environmental impact of nation's network of military bases
- 1 e. Administers programs with funding for agricultural conservation activities and administers farm programs
- 4 f. Works to ensure efficient mining, processing, use, and recycling of mineral resources
- 9 g. Helps protect the nation's birds, mammals, fish, and other wildlife
- 10 h. Works to manage and protect forestland and grassland while promoting their best use
- 14 i. Conducts surveys of the land and its resources and develops maps based on these surveys
- 8 j. Determines environmental standards and enforces federal environmental laws
- 13 k. Responsible for environmental integrity of federal lands along navigable public waterways
- 12 l. Helps prevent soil erosion from wind and water
- 11 m. Manages more than 300 areas within the national parks system

Written Test—Answer Key

Objective 17

List five types of occupations in natural resources.

Any five of the following:

- Occupations that maintain and protect natural resources
- Occupations that collect and harvest natural resources
- Occupations that make products from natural resources
- Occupations that use products made from natural resources
- Occupations that convert natural resources to energy
- Occupations that provide services
- Occupations that enforce laws affecting natural resources
- Occupations that dispose of waste

Objective 18

List three ways of getting a job in natural resources.

Any three of the following:

- Identify government agencies and private industries that have jobs of interest to you
- Become familiar with businesses and industries involved with natural resources
- Request information and brochures related to your interests
- Get job-related experience as soon as possible
- Determine education required for various jobs
- Secure summer employment or volunteer work in a related area
- Get to know local individuals working in natural resources.

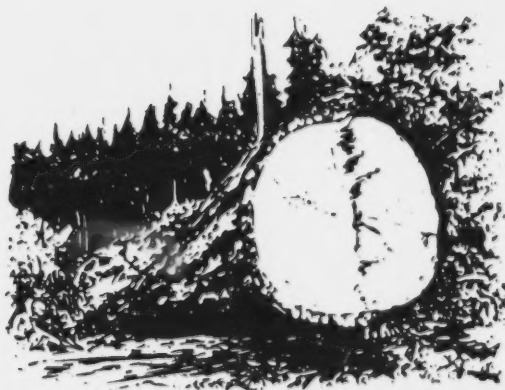
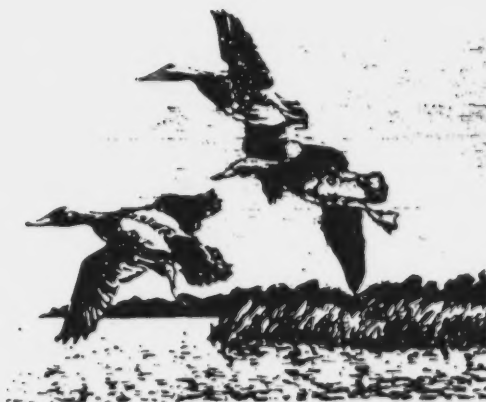
Objective 19

List three characteristics of a person working in natural resources.

Any three of the following:

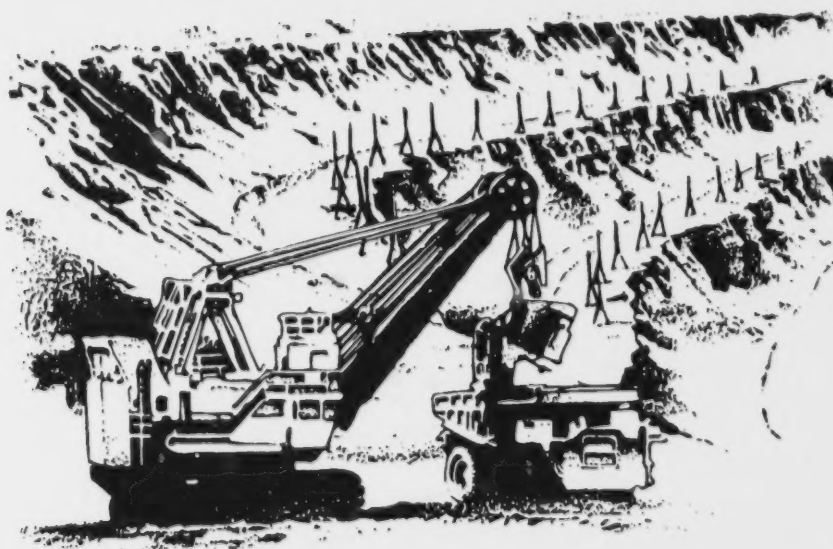
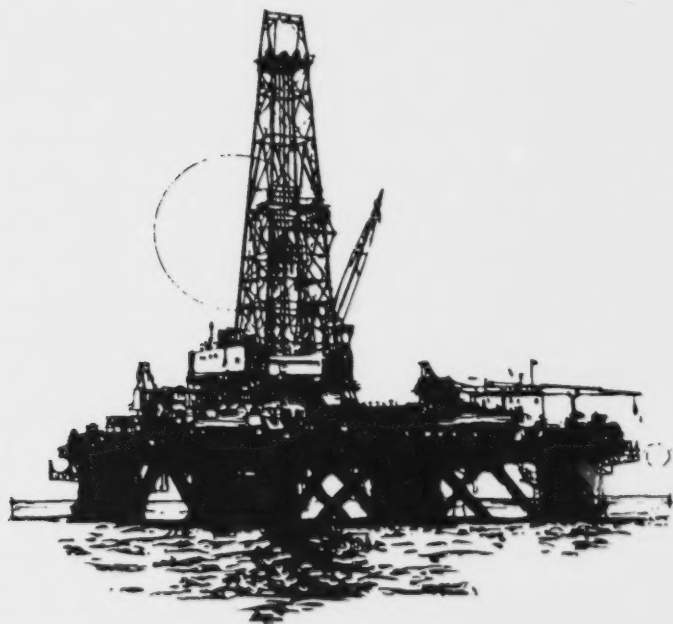
- Desires to work outdoors;
- Desires to work in agricultural-related areas;
- Has a concern for the environment;
- Likes to interact with the natural environment;
- Likes to work with people.

Renewable Natural Resources



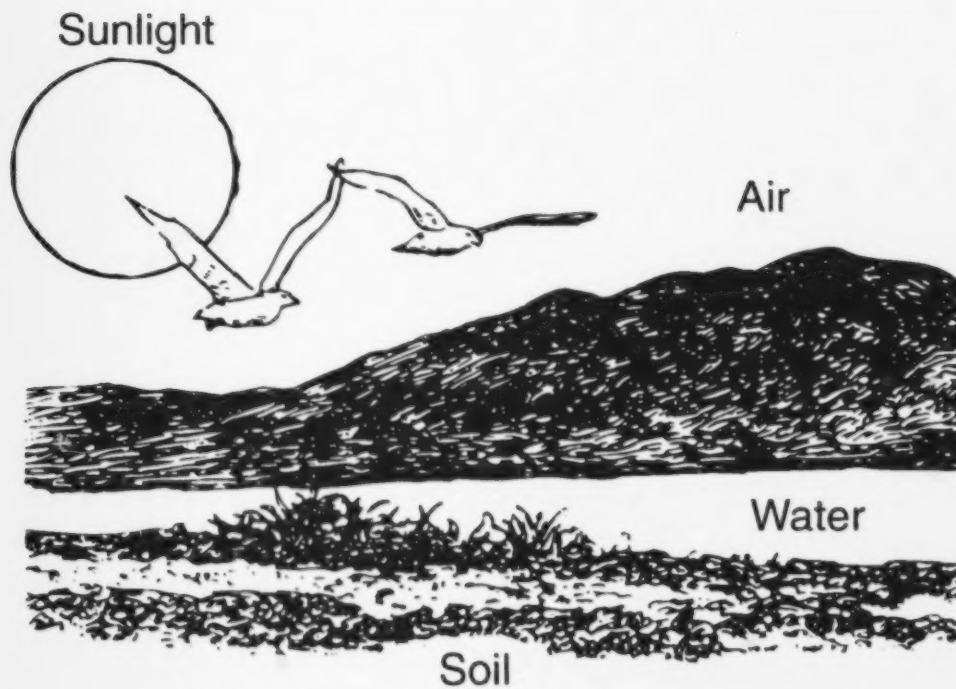
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Nonrenewable Natural Resources



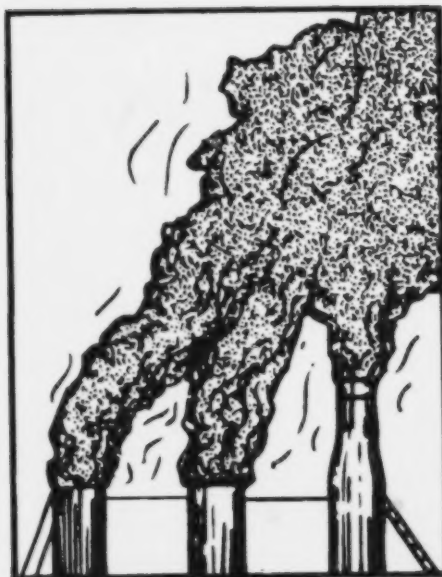
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Basic Components of the Physical Environment



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Types of Pollution



Air Pollution

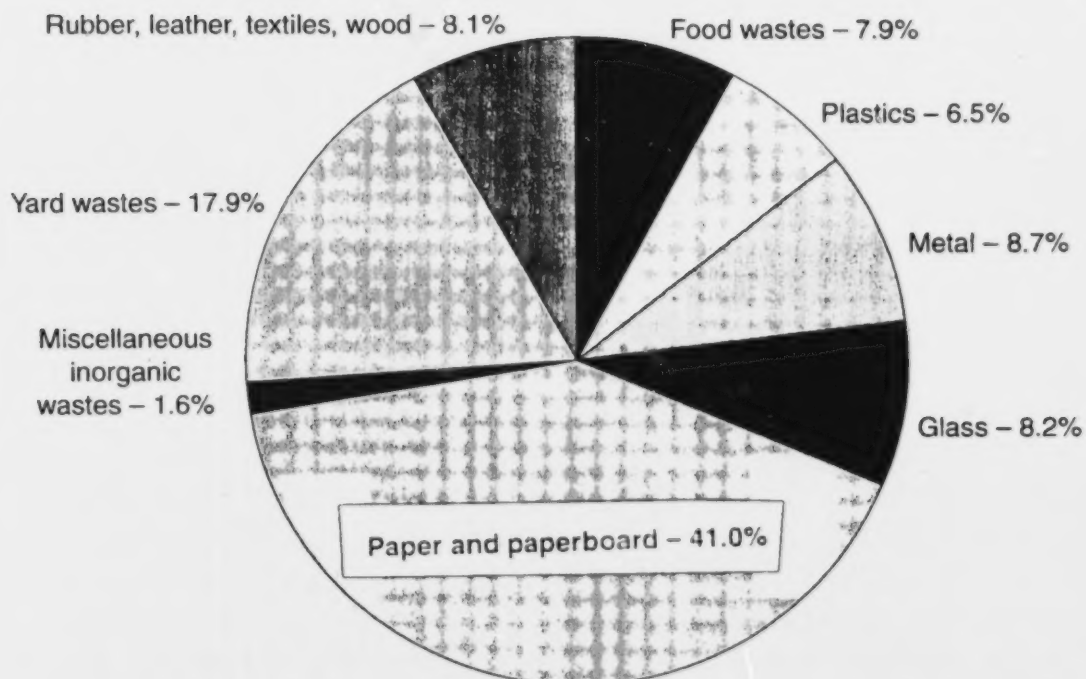


Water Pollution

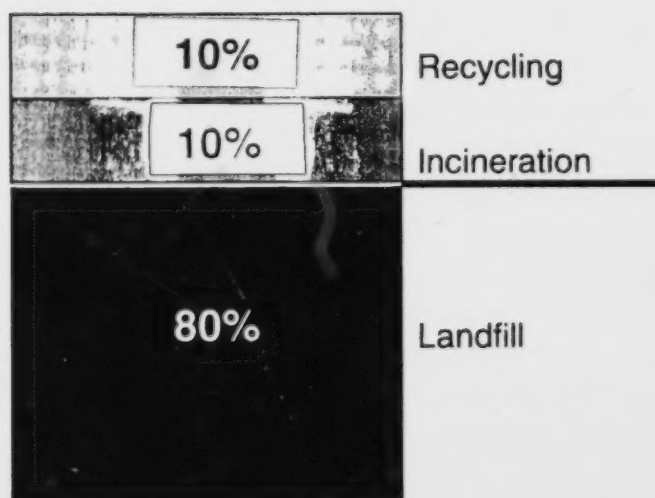


Land Pollution

Composition of Solid Waste



Composition of Municipal Waste in a Typical Landfill



How U.S. Disposes of Its Solid Waste

Unit 3**Water Resource Management**

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* Assignment Sheets are located in the Student Workbook.

Instructional
Plan

Suggested Activities

Preparation

- Review the objective sheet. Study the specific objectives to determine the order in which you will present the objectives.
- Review the suggested lesson plan. The plan identifies an order for instruction to take place. Each "day" represents a 50-minute class period. The plan is designed to cover the specific objectives over a 15-day period. Additional days and/or activities may be added. (Note: You may want to change days to specific dates. Example: Day 1 may become Monday, October 1, Day 2 = Tuesday, October 2, and so forth.) You will want to localize, supplement, and personalize the plan to fit your situation.
- Review the teaching suggestions included in this instructional plan section to plan classroom activities. Also, note the suggestions for suggested supplemental resources.
- Plan your presentation to take advantage of student learning styles and to accommodate special-needs students.
- Obtain various resources such as films, videotapes, water test kits, laboratory equipment, and other material to supplement instruction of this unit. See "Resources Used in Developing This Unit" and "Suggested Supplemental Resources" for more information.
- Make transparencies or computer presentation from the transparency masters included in this unit. These appear in the teacher edition only and should be used with objectives as indicated below.

TM 1—Hydrologic (Water) Cycle (Objective 5)

TM 2—Surface Water Contamination (Objective 6)

TM 3—Ground Water Contamination (Objective 7)

- Use the following teacher supplements to enhance your delivery and applications.
 - TS 1—How Precious is Freshwater? (Introduction or Objectives 2 and 3)
 - TS 2—How Does the Hydrologic Cycle Work? (Objective 5)
 - TS 3—Understanding Contaminant Residues by Using Parts Per Million (Objective 13)
 - TS 4—Research EPA "Superfund" Sites in Your State

Suggested Activities

- Use the following student supplements to supplemental instruction.
SS 1—Water Facts (Introduction or Objective 3)
SS 2—Water Conservation Methods for Household Activities (Objective 13)
SS 3—Maximum Contamination Levels and Lifetime Health Advisories (Objective 13)
- Select teacher components (teacher supplements, written test, unit review) you want to distribute to your students. Copy and prepare these components for distribution.
- Prepare classroom. Put up posters and charts and display articles and other references related to the objectives of this unit.

Delivery and Application

- Discuss unit and specific objectives.
- Discuss information sheets. Implement teaching plan to localize, supplement, and personalize unit. Reinforce basic academic and workplace skills when applicable.
- Discuss assignment sheets. Review with students the criteria for evaluation of each of these activities.

Teaching Suggestions

The skill areas appearing in bold-face type in the teaching suggestions refer to the academic and workplace skills identified in *What Work Requires of Schools: A SCANS Report for America 2000* and *Workplace Basics: The Skills Employers Want*. These have been adapted by MAVCC.

- Invite a representative of a municipal or rural water distribution system to address the class on the mechanics of providing clean, safe, economical water to thousands of customers on a daily basis. Provide students with an opportunity to prepare and ask questions concerning the water service to assist them in completing Assignment Sheet 1. (**Listening; writing; acquiring scientific information; problem solving**)

Suggested Activities

- Invite a representative of a federal, state or local environmental agency or water resources board to discuss water pollution problems in your area. Assign students to small teams to survey your community or county for sources of water pollution or for potential water pollution problems. See Assignment Sheet 2 in this unit. Have each team prepare a report on the information they gathered, and have them recommend possible solutions to the problems they identified. Then have the class compile their reports into one document. (**Speaking; listening; writing; acquiring scientific information; interpersonal relations; teamwork; problem solving**)
- Visit a local municipal waste water treatment plant and/or have a resource person from a local plant visit the class on how waste water is treated in your community. (**Listening; acquiring and evaluating information**)
- Arrange a class field trip led by this representative to see the water distribution system in action. Assign class members a written report covering the overall operation of the water system studied with a creative component asking them to compare safety, cost, dependability, etc. of the local water system with that of people who depend upon a home well for drinking water. (**Speaking; listening; writing; critical thinking; acquiring and evaluating information**)
- Assign Assignment Sheet 3 to begin on a Friday so students will have the weekend to record usage. Students will have two days to complete the activity. They will have a better opportunity to be home the entire day. Have students compare and discuss their daily water consumption. (**Acquiring and applying scientific knowledge; listening; critical thinking**)
- Have students calculate the cost of water. Assignment Sheet 4 uses a water bill to achieve this task. Rural students may want to determine the costs associated with well water (digging, pump, annual testing, electricity, etc.) The following questions may be appropriate for the rural student.
 1. What was the cost to dig the well?
 2. How many gallons are used per month?
 3. How much electricity was used to pump the water?
 4. How much does it cost to have the water treated?
 5. If a home water-treatment system is used, how much did the water-treatment system cost and what are the monthly maintenance costs?

Suggested Activities

- Obtain inexpensive water test kits. To keep control costs, provide several kits to teams of students in the class, and assign them various water sources to sample and test. Examples might include the water fountain in the school hall, a water hydrant at a local or state park, home water supplies, or water from a nearby stream. After samples have been tested, have students give an oral report to the class on their findings and why they think the findings are accurate or inaccurate. **(Acquiring scientific information; applying scientific techniques; teamwork; critical thinking; speaking; listening)**
- Discuss water conservation and use and assign class members a project in which they survey water-wasting appliances and techniques during a week of observation. Also have them visit hardware and home improvement stores to report on water-saving devices and repair kits available in your local area. Have students report their findings to the class. **(Speaking; listening; critical thinking; teamwork; acquiring information)**
- Invite a representative of the local USDA Natural Resource Conservation Service to discuss the "Know Your Watershed" project. Use topographical maps of the local area for the class members to designate the watershed in which their school lies. **(Listening; acquiring and applying scientific knowledge)**

Evaluation

- Give and evaluate Water Resource Management Review.
- Copy written test and give to students as pretest.
- Evaluate the assignment sheets. See the evaluation criteria listed at the top of teach assignment sheet. Evaluation criteria may be localized, personalized or individualized to fit your situation. Record student's grade in your grade book.
- Give and evaluate written test. Record student's written test score in your grade book and on the student's competency profile.
- Measure competency gains by comparing written pretest scores with posttest scores.
- Meet individually with students to evaluate their progress through this unit of instruction and indicate to them possible areas of improvement.
- Reteach and retest as required.

Suggested Activities

Instructions for Evaluating Student Performance

- When the student is ready to perform a specific task, obtain a copy of the assignment sheet which may be found in the student workbook.
- Once the student has completed an assignment sheet, evaluate the student's work using the evaluation criteria. If the student's work is unsatisfactory, have the student review the assignment and submit their work for evaluation again. Record the appropriate level of competency on the student's competency profile.
- Sample performance evaluation keys have been provided below. Many other keys are available. Select one rating scale, which best fits your program needs.

Option A

- 4—**Skilled**—Can perform job with no additional training.
- 3—**Moderately skilled**—Has performed job during training program; limited additional training may be required.
- 2—**Limited skill**—Has performed job during training program; additional training is required to develop skill.
- 1—**Unskilled**—Is familiar with process, but is unable to perform job.
- 0—**No exposure**—No information or practice provided during training program.

Option B

- Yes**—Can perform job with no additional training.
- No**—Is unable to perform job satisfactorily.

- Encourage students to continue their portfolio. The portfolio should become a record of the student's progress in the study of natural resources.

Resources Used in Developing This Unit

Note: URLs change frequently. Any of the web sites below may have moved.

- Camp, William G. and Thomas B. Daugherty. *Managing Our Natural Resources—4th Edition*. Albany, NY: Delmar Publishers Inc., 2002.
www.agriscience.delmar.com
- Lee, Jasper S., *Natural Resources and Environmental Technology*. Interstate Publishers, Inc., Danville, IL, 2000.
www.interstatepublishers.com
- Porter, Lynn, Jasper S. Lee, Diana L. Turner, and J. Malcolm Hillan, *Environmental Science Technology—2nd Edition*. Interstate Publishers, Inc., Danville, IL, 2003.
www.interstatepublishers.com
- Birkenholz, Robert J. and Bryan L. Garton, *Applied Environmental Science*, Natural Council for Agricultural Education, 1996

Suggested Activities

Suggested Supplemental Resources

- Books, pamphlets, videotapes, and visiting speakers related to water conservation and pollution control are available from each state's office of the USDA Natural Resources Conservation Service. Each state has district NRCS offices where resources can be obtained. The NRCS web site is: www.nrcs.usda.gov

- Obtain inexpensive do-it-yourself water test kits at local mass merchandisers (Walmart, Kmart, Lowes, etc.) designed to test for chlorine, hardness, pH, nitrate/nitrite and iron presence in drinking water. These kits employ easy-to-use color-coded dip strips.

- Review web sites for water testing kits. Three examples are:

NASCO on-line catalogs at www.enasco.com. Click Educational Materials – Agricultural Sciences — Testing Equipment — Water Testing Equipment. NASCO can also customize educational kits to fit your needs.

Watertesters.com is an internet service for water test kits (various prices). Has a "water profile test" that allows a person to check the situation that best describes their household water then program suggests the right test for the situation.

Contact: www.watertesters.com

Do-it-yourself water testing kits for bacteria, lead, pesticides, and other contaminants. Contact: www.testyourwater.com. Click Kits for School – Water Test Kits.

- Contact your local Cooperative Extension Service office to inquire about the availability of water testing or performing a water quality analysis.
- American Clean Water Foundation – a non-profit, Washington, D.C. based organization that specializes in outreach and education services on clean water issues. Coordinated 30th anniversary of Clean Water Act with "Year of Clean Water" activities in 2002. Source of water resource links. For more information contact: www.acwf.org

Suggested Lesson Plan**Day 1**

Introduction:

- Discuss unit objective and review specific objectives and plan for completing this unit.
- Have students read introductory statement.
- Discuss the importance of studying Water Resource Management.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 2—History of the importance of water in the United States.
- Discuss Objective 3—Water distribution.
- Have students read Student Supplement 1—Water Facts.
- Use Teacher Supplement 1 to illustrate how precious is freshwater.

Closure:

- Review Objectives 2 and 3.

Evaluation:

- Non-applicable.

Day 2

Introduction:

- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 4—Uses of water.
- Discuss Objective 5—Hydrologic (water) cycle.
- Use TM 1 to illustrate hydrologic (water) cycle.
- Use Teacher Supplement 2 to demonstrate how the hydrologic (water) cycle works.
- Assign Assignment Sheet 1—Evaluate Your Source of Drinking Water. Discuss introduction, directions, and evaluation criteria.
- Assign due date for Day 4.

Closure:

- Review Objectives 4 and 5.

Evaluation:

- Non-applicable.

Day 3

Introduction:

- Discuss progress on Assignment Sheet 1.
- State the objectives for today's lesson.

Suggested Lesson Plan

Day 4

Delivery and Application:

- Discuss Objective 6—Surface water.
- Use TM 2 to illustrate surface water contamination.
- Discuss Objective 7—Ground water.
- Use TM 3 to illustrate ground water contamination.
- Discuss Objective 8—Relationship between ground water and surface water.
- Have supervised study for students to work on Assignment Sheet 1.

Closure:

- Review Objectives 6, 7, and 8.
- Remind students Assignment Sheet 1 is due at beginning of next class.

Evaluation:

- Non-applicable.

Introduction:

- Review evaluation criteria for Assignment Sheet 1.
- State the objectives for today's lesson.

Delivery and Application:

- Have students discuss their findings from Assignment Sheet 1. Compare findings for each question.
- Have student turn in Assignment Sheet 1.
- Discuss Objective 9—Water pollution.
- Assign Assignment Sheet 2—Survey Your Area to Identify Water Pollution Sources.
- Discuss introduction, directions, and evaluation criteria.
- Assign due date for Day 7.

Closure:

Review Objective 9.

Evaluation:

- Evaluate student performance on Assignment Sheet 1 according to criteria listed on assignment sheet.
- Record assignment sheet grade in grade book.
- Record appropriate competency level on each student's competency profile.

Day 5

Introduction:

- Return evaluated Assignment Sheet 1 to students. Discuss, if applicable.
- Discuss progress on Assignment Sheet 2.
- State the objectives for today's lesson.

Suggested Lesson Plan

Day 6

Delivery and Application:

- Discuss Objective 10—Comparison of the environment – 1960 and now.
- Assign Assignment Sheet 3—Determine Ways to Reduce Home Water Consumption.

Note: Best to assign on Friday to be completed over weekend (see Teaching Suggestions).

- Discuss introduction, directions, and evaluation criteria.
- Review Student Supplement 1.
- Read and discuss Student Supplement 2—Water Conservation Methods for Household Activities.
- Assign due date for Day 8.

- Have supervised study for students to work on Assignment Sheet 2.

Closure:

- Review Objective 10.

Evaluation:

- Non-applicable.

Introduction:

- Review progress on Assignment Sheet 2.
- Review progress on Assignment Sheet 3.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 11—Hazardous/toxic waste.
- Have supervised study for students to complete Assignment Sheets 2 and 3.

Closure:

- Review Objective 11.
- Remind students Assignment Sheet 2 is due at beginning of class on Day 7.

Evaluation:

- Non-applicable.

Day 7

Introduction:

- Remind students that Assignment Sheet 2 is due.
- Review progress on Assignment Sheet 3.
- State the objectives for today's lesson.

Delivery and Application:

- Have students discuss their finding from Assignment Sheet 2.
- Have students turn in Assignment Sheet 2.
- Discuss Objective 12—Roles of government agencies and policies to ensure environmental protection of water resources.
- Have supervised study for students to work on Assignment Sheet 3.

Suggested Lesson Plan

Day 8

Closure:

- Review Objective 12.
- Remind students Assignment Sheet 3 is due on Day 8.

Evaluation:

- Evaluate student performance on Assignment Sheet 2 according to criteria listed on assignment sheet.
- Record assignment sheet grade in grade book.
- Record appropriate competency level on each student's competency profile.

Introduction:

- Return evaluated Assignment Sheet 2 to students. Discuss, if applicable.
- Discuss progress on Assignment Sheet 3 due today.
- State the objectives for today's lesson.

Delivery and Application:

- Have students discuss their findings from Assignment 3.
 - Compare household or personal water usage.
 - Discuss ways to reduce the amount of household or personal water usage.
- Have students turn in Assignment 3.
- Discuss Objective 13—Watersheds.
- Discuss Objective 14—Water measurements.

Closure:

- Review Objective 13.

Evaluation:

- Evaluate student performance on Assignment Sheet 3 according to criteria listed on assignment sheet.
- Record assignment sheet grade in grade book.
- Record appropriate competency level on each student's competency profile.

Day 9

Introduction:

- Return evaluated Assignment Sheet 3 to students. Discuss, if applicable.
- State the objectives for today's lesson.

Delivery and Application:

- Review Objective 13.
- Assign Assignment Sheet 4—Calculate the Cost of Water.
 - Discuss introduction, directions, and evaluation criteria.
 - Assign due date for end of class.
- Provide supervised study for completion of Assignment Sheet 4.

Closure:

- Have students turn in Assignment Sheet 4.

Suggested Lesson Plan

Day 10

Evaluation:

- Evaluate student performance on Assignment Sheet 4 according to criteria listed on assignment sheet.
- Record assignment sheet grade in grade book.
- Record appropriate competency level on each student's competency profile.

Introduction:

- Return evaluated Assignment Sheet 4 to students. Discuss, if applicable.
- State the objectives for today's lesson.

Delivery and Application:

- Review Objective 13.
- Use Teacher Supplement 3 to illustrate contaminant residues using parts per million.
- Assign Assignment Sheet 5—Calculate and Draw Conclusions from Water Measurements.
 - Discuss introduction, directions, and evaluation criteria.
 - Discuss Student Supplement 3—Maximum Contaminant Levels and Lifetime Health Advisories.
 - Assign Assignment Sheet 5 due date for Day 11.
- Provide supervised study for completion of Assignment Sheet 5.

Closure:

- Remind students Assignment Sheet 5 is due Day 11.

Evaluation:

- Non-applicable.

Day 11

Introduction:

- Discuss progress on Assignment Sheet 5 due today.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Assignment Sheet 5.
- Have students turn in Assignment Sheet 5.
- Discuss Objective 15—Career opportunities in water resource management.
- Assign Assignment Sheet 6—Analyze Current Reports Concerning Water Resource Management.
 - Discuss introduction, directions, and evaluation criteria.
 - Assign Assignment Sheet 6 due date for Day 15.
- Provide supervised study for work on Assignment Sheet 6.

Closure:

- Review Objective 15.
- Discuss written test to be taken on Day 14.

Suggested Lesson Plan

Day 12

Evaluation:

- Evaluate student performance on Assignment Sheet 4 according to criteria listed on assignment sheet.
- Record assignment sheet grade in grade book.
- Record appropriate competency level on each student's competency profile.

Introduction:

- Return evaluated Assignment Sheet 4 to students. Discuss, if applicable.
- State the objectives for today's lesson.

Delivery and Application:

- Review for written test.
- Have students complete Water Resource Management Review.
- Provide supervised study for students who have completed the Water Resource Management Review to work on Assignment Sheet 6.

Closure:

- Have students turn in Water Resource Management Review.

Evaluation:

- Evaluate Water Resource Management Review.
- Record grade for review in grade book.

Day 13

Introduction:

- Return evaluated Review to students. Review answers.
- Review progress on Assignment Sheet 6.
- Remind students of written test on Day 14.
- State the objectives for today's lesson.

Delivery and Application:

- Review for written test: Terms and definitions.
- Provide supervised study for students to review for written test or work on Assignment Sheet 6.

Closure:

- Remind students of written test on Day 14.
- Remind students of Assignment Sheet due date Day 15.

Evaluation:

- Non-applicable.

Day 14

Introduction:

- Review for written test.
- Review progress on Assignment Sheet 6.
- State the objectives for today's lesson.

Delivery and Application:

- Give written test.
- Have students that have completed written test work on Assignment Sheet 6.

Suggested Lesson Plan

Day 15

Closure:

- Review expectations for Assignment Sheet 6 due Day 15.

Evaluation:

- Evaluate written test.
Note: Develop teaching strategies for students who did achieve minimum score.
- Record written test grade in grade book.
- Record written test grade on each student's competency profile.

Introduction:

- Return written test and review answers.
- Discuss strategies for students who did not achieve the minimum score.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss findings from Assignment Sheet 6.
- Have students turn in Assignment Sheet 6.

Closure:

- Review unit objectives.
- Review next lesson.

Evaluation:

- Evaluate student performance on Assignment Sheet 6 according to criteria listed on assignment sheet.
- Record assignment sheet grade in grade book.
- Record appropriate competency level on each student's competency profile.

Water Resources Management Review

Name _____ Overall Rating _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate serious effort was taken in completing review	_____

Introduction

Water is essential for life and plays a vital role in the proper function of the Earth's ecosystems. The pollution of water has an impact on all living creatures and can negatively affect the use of water for drinking, household needs, recreation, fishing, transportation, and commerce. It is important for you to understand the role water resource management plays in your life.

Directions

Answer the following questions concerning water resource management. For help, refer to the information sheets and student supplements found in this unit. Circle the correct response for each question.

1. Surface water is:
 - a. Water which has evaporated and is suspended in the air.
 - b. Continuous circulation of water between the oceans, atmosphere, and the earth's surface.
 - c. Water which is made chemically, biologically, or physically impure or unfit for use.
 - d. Water visible on the earth's surface.
2. Sand, gravel, or rock formation found below the earth's surface which is saturated with water is:
 - a. Ground water.
 - b. A septic system
 - c. An aquifer.
 - d. Water vapor.
3. Hazardous (toxic) waste is:
 - a. Metallic elements with high molecular weights, generally toxic to plant and animal life.
 - b. Waste that poses a serious threat to human health even at extremely low concentrations.
 - c. Water which is made chemically, biologically, or physically impure or unfit to use.
 - d. Water which seeps through the earth's surface and into ground water aquifers.

Review

4. Select the true statement concerning the history of the importance of water in the U.S.
 - a. Most organisms can survive without water.
 - b. In the 1800's and early 1900's, water was not an important natural resource.
 - c. As the United States was settled, the availability of water was a prime concern.
 - d. Industry does not require much water.
5. About _____ of the surface water is salt water contained in the oceans.
 - a. 71%
 - b. 97%
 - c. 50%
 - d. 3%
6. Only _____ of the freshwater in the U.S. exists in streams and lakes.
 - a. 2%
 - b. 1%
 - c. 3%
 - d. 9%
7. The volume of ground water that is economically recoverable in the U.S. is equal to _____ times the volume of the Great Lakes.
 - a. 9
 - b. 3
 - c. 10
 - d. 6
8. The hydrologic cycle is:
 - a. Water which accumulates after a rain.
 - b. A vehicle which runs on water.
 - c. Continuous circulation of water between the oceans, atmosphere, and the earth's surface.
 - d. A whirlpool caused by rotating water.
9. Water exists in various forms. They are:
 - a. Liquid and vapor.
 - b. Solid, vapor, and gas.
 - c. Vapor, solid, and liquid.
 - d. Solid and liquid.

10. An example of surface water is:
 - a. An aquifer.
 - b. A lake.
 - c. A water well.
 - d. An artesian well.
11. Ground water:
 - a. Exists as lakes and rivers underground.
 - b. Is located at depths over 100 feet.
 - c. Moves rapidly from a mile to several miles per day.
 - d. Is used by half of all Americans and 95% of rural Americans for drinking water.
12. _____ describes the relationship between ground water and surface water.
 - a. Changes in ground water quality or quantity will never affect surface water.
 - b. Surface water supplies the base flow for all streams and rivers.
 - c. Changes in surface water quality or quantity can affect ground water quality and quantity.
 - d. Surface water will never enter ground water formations.
13. Point source pollution:
 - a. Can be traced to a point of discharge.
 - b. Enters the environment from a wide area.
 - c. Is a location where hazardous waste poses a potential threat to the environment.
 - d. Is the total drainage area where water flows to a common point.
14. Which statement describes the state of the environment in 1960.
 - a. Pesticides were classified and their use is regulated.
 - b. Transport of hazardous chemical is regulated.
 - c. Sediment from mining operations and lumber mills are monitored and controlled.
 - d. Surface water and ground waters were severely polluted.
15. Select a true statement concerning hazardous (toxic) waste.
 - a. If hazardous waste is placed in dumps and covered with soil, it is safe.
 - b. Municipal landfills pose no threat to the environment.
 - c. Underground storage tanks are not an environmental problem.
 - d. Improper hazardous waste disposal is a serious threat to water resources.

Review

16. The purpose of the quality assurance role of government is to:
 - a. Recognize the role of sustainable economic development.
 - b. Promote or stifle environmental concerns.
 - c. Assure safe supplies of food, water, and air.
 - d. Assure that past environmental damage is cleaned up.
17. A watershed:
 - a. Is where the water starts (source).
 - b. Is the total drainage area where water flows to a common point.
 - c. Is often called a spring.
 - d. Is never harmed by human activities.
18. Water flow is measured in:
 - a. Parts per million (PPM).
 - b. Parts per billion (PPB).
 - c. Gallons per minute (GPM)
 - d. Milligram per liter (mg/l)
19. An acre foot (for lake water volumes) is:
 - a. 1000 milliliters.
 - b. 1 acre of water covering one acre.
 - c. 7.46 gallons.
 - d. 10,000 gallons.

Water Resources Management Review—Answer Key

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate serious effort was taken in completing review	_____

1. Surface water is:
 - a. Water which has evaporated and is suspended in the air.
 - b. Continuous circulation of water between the oceans, atmosphere, and the earth's surface.
 - c. Water which is made chemically, biologically, or physically impure or unfit for use.
 - d. **Water visible on the earth's surface.**
2. Sand, gravel, or rock formation found below the earth's surface which is saturated with water is:
 - a. Ground water.
 - b. A septic system
 - c. **An aquifer.**
 - d. Water vapor.
3. Hazardous (toxic) waste is:
 - a. Metallic elements with high molecular weights, generally toxic to plant and animal life.
 - b. **Waste that poses a serious threat to human health even at extremely low concentrations.**
 - c. Water which is made chemically, biologically, or physically impure or unfit to use.
 - d. Water which seeps through the earth's surface and into ground water aquifers.

Review—Answer Key

4. Select the true statement concerning the history of the importance of water in the U.S.
 - a. Most organisms can survive without water.
 - b. In the 1800's and early 1900's, water was not an important natural resource.
 - c. **As the United States was settled, the availability of water was a prime concern.**
 - d. Industry does not require much water.
5. About _____ of the surface water is salt water contained in the oceans.
 - a. 71%
 - b. **97%**
 - c. 50%
 - d. 3%
6. Only _____ of the freshwater in the U.S. exists in streams and lakes.
 - a. **2%**
 - b. 1%
 - c. 3%
 - d. 9%
7. The volume of ground water that is economically recoverable in the U.S. is equal to _____ times the volume of the Great Lakes.
 - a. **9**
 - b. 3
 - c. 10
 - d. 6
8. The hydrologic cycle is:
 - a. Water which accumulates after a rain.
 - b. A vehicle which runs on water.
 - c. **Continuous circulation of water between the oceans, atmosphere, and the earth's surface.**
 - d. A whirlpool caused by rotating water.
9. Water exists in various forms. They are:
 - a. Liquid and vapor.
 - b. Solid, vapor, and gas.
 - c. **Vapor, solid, and liquid.**
 - d. Solid and liquid.

Review—Answer Key

10. An example of surface water is:
- a. An aquifer.
 - b. A lake.**
 - c. A water well.
 - d. An artesian well.
11. Ground water:
- a. Exists as lakes and rivers underground.
 - b. Is located at depths over 100 feet.
 - c. Moves rapidly from a mile to several miles per day.
 - d. Is used by half of all Americans and 95% of rural Americans for drinking water.**
12. _____ describes the relationship between ground water and surface water.
- a. Changes in ground water quality or quantity will never affect surface water.
 - b. Surface water supplies the base flow for all streams and rivers.
 - c. Changes in surface water quality or quantity can affect ground water quality and quantity.**
 - d. Surface water will never enter ground water formations.
13. Point source pollution:
- a. Can be traced to a point of discharge.**
 - b. Enters the environment from a wide area.
 - c. Is a location where hazardous waste poses a potential threat to the environment.
 - d. Is the total drainage area where water flows to a common point.
14. Which statement describes the state of the environment in 1960.
- a. Pesticides were classified and their use is regulated.
 - b. Transport of hazardous chemical is regulated.
 - c. Sediment from mining operations and lumber mills are monitored and controlled.
 - d. Surface water and ground waters were severely polluted.**
15. Select a true statement concerning hazardous (toxic) waste.
- a. If hazardous waste is placed in dumps and covered with soil, it is safe.
 - b. Municipal landfills pose no threat to the environment.
 - c. Underground storage tanks are not an environmental problem.
 - d. Improper hazardous waste disposal is a serious threat to water resources.**

Review—Answer Key

16. The purpose of the quality assurance role of government is to:
- a. Recognize the role of sustainable economic development.
 - b. Promote or stifle environmental concerns.
 - c. Assure safe supplies of food, water, and air.**
 - d. Assure that past environmental damage is cleaned up.
17. A watershed:
- a. Is where the water starts (source).
 - b. Is the total drainage area where water flows to a common point.**
 - c. Is often called a spring.
 - d. Is never harmed by human activities.
18. Water flow is measured in:
- a. Parts per million (PPM).
 - b. Parts per billion (PPB).
 - c. Gallons per minute (GPM)**
 - d. Milligram per liter (mg/l)
19. An acre foot (for lake water volumes) is:
- a. 1000 milliliters.
 - b. 1 acre of water covering one acre.**
 - c. 7.46 gallons.
 - d. 10,000 gallons.

Teacher Supplement 1—How Precious is Freshwater?**Purpose**

To demonstrate that freshwater is a scarce commodity.

Materials needed

- 5 – one gallon jugs
- 2 – glass quart jars
- 1 – measuring cup

Procedure

1. Fill the one-gallon jugs (640 ounces) with tap water and place them in front of the room.

Question: **Since 97% of the world's water is salt water and 3% of the world's water is freshwater; how much of the 5 gallons represent the amount of freshwater in the world?**

Answer: $640 \text{ ounces} \times .03 = 19.2$ or 20 ounces (Hint: 8 ounces = 1 cup; 16 ounces = 1 pint; 128 ounces = one gallon)

2. Measure $2\frac{1}{2}$ cups (20 ounces) of water out of one of the gallon jugs and place in quart jar #1. (This represents the total freshwater available in the world.)

Question: **Since 77% of the world's freshwater is found in polar icecaps and 23% is found in surface waters and ground water; how much of the 20 ounces represents the amount of freshwater for human use?**

Answer: $20 \text{ ounces} \times .23 = 4.6$ ounces or $\frac{2}{3}$ cup.

3. Measure out $\frac{2}{3}$ of a cup of water out of quart jar #1 and pour into quart jar #2. (This represents the amount of freshwater available for human use.)

Thoughts

- Explain that quart jar #2 represents all the surface and ground water sources that are available for human consumption.
- Explain that a small percentage of this water lies too deep in the earth to be accessed for human consumption.

Teacher Supplement 2—How Does the Hydrologic Cycle Work?**Purpose**

Demonstrate the steps associated with the hydrologic cycle.

Materials needed

- Clear mixing bowl
- Small cup
- Plastic wrap
- Small weight
- Cellophane tape
- Water
- Sunny day (Needed for demonstration to work properly)

Procedure

1. Place an empty cup in the center of the mixing bowl.
2. Pour water into the mixing bowl surrounding the cup, but do not allow the cup to float or get water in the cup.
3. Cover the mixing bowl with the plastic wrap allowing the center to sag. Use tape, if necessary, to assure proper seal around the bowl.
4. Place the small weight in the center of the plastic wrap allowing a permanent sag.
5. Set the bowl in the sunlight.
6. Have students hypothesize what will happen.

Results

- The sunlight will evaporate the water in the mixing bowl, which condenses on the plastic wrap. The condensation will trickle down the plastic wrap and drop into the cup in the center of the bowl.
- The water in the bowl represents the **hydrosphere**.
- The plastic wrap represents the **atmosphere**.
- The cup represents the **biosphere** and **lithosphere**.

Teacher Supplement 3—Understanding Contaminant Residues by Using Parts Per Million**Purpose**

This demonstration will help students understand the minute concentrations of toxic residues when figuring drinking water standards used in Objective 14 and Assignment Sheet 5.

Materials needed

- Three (3) one-liter plastic bottles or beakers
- Food coloring for pollutant
- Eye or medicine dropper

Procedure

1. Fill three bottles or beakers with 999 milliliters of clean water.
2. In the first bottle, add one milliliter of food coloring or approximately 20 drops. Shake well. This bottle represents 1 part per thousand. Observe the color change.
3. Extract one milliliter or approximately 20 drops from the well-mixed first bottle and add the amount to the second bottle. Shake well. This bottle represents 1 part per million. Observe the color change.
4. Extract one milliliter or approximately 20 drops from the well-mixed second bottle and add the amount to the third bottle. Shake well. This bottle represents 1 part per billion. Observe the color change. There should be virtually no color change in the third bottle.

Alternative activity

1. Use the same three bottles of water, but add a drop of gasoline and use the same dilution process.
2. Does the odor of the gasoline remain at 1 part per thousand? 1 part per million? 1 part per billion?
3. The human threshold for gasoline odor is about 5 parts per billion.
4. This activity demonstrates that diluting pollutants is not an adequate solution to the problem of water pollution.

Teacher Supplement 4—Research EPA “Superfund” Sites in Your State

Evaluation Criteria	Rating
• Report is complete and well documented	_____
• Assignment is neat	_____
• Assignment was completed on time	_____

Introduction

In an effort to clean up severely polluted areas around the U.S., the Environmental Protection Agency has established a so-called “Superfund” for cleanup of specific sites it determines to be the most urgently in need of attention. Many times these include old strip mine pits, sites of smelters, hazardous waste dumps of the past, etc. This assignment is aimed at acquainting you with the pros and cons of so-called “Superfund” clean-up projects and the number of these sites in your own state.

Directions

Use the following list of questions to research the “Superfund” activity in your state and to document the status of those sites. Also, collect information on the activities that caused the sites to become polluted, and research the overall acceptance of the “Superfund” classification of residents near the sites. With the information you gather for this project, write a report detailing your state’s “Superfund” activity, when it should be complete, and a personal assessment of the overall environmental effectiveness of the program in your state.

1. How many Superfund sites are established in your state?
2. Which of these sites are actively being cleaned under the auspices of the EPA Superfund?
3. If any are not being modified under EPA Superfund regulations, why are they not?
4. List the reasons why each site became polluted, when it became polluted, and note the threats to the environment posed by each.
5. Determine the amount of federal appropriations through the Superfund that is allotted to clean up of each site. Also determine the total amount of Superfund dollars your state may expect to be spent when all sites have been dealt with.
6. If communities near Superfund sites in your state have objected to the classification, research local and state newspaper accounts to determine why they don’t want Superfund status.

Teacher Supplement 4

7. Through local and state newspaper accounts of the Superfund sites in your state, determine if you think Superfund status is really justified. Why or why not?

Answers to Assignment Sheets**Assignment
Sheet 1****Evaluate Your Source of Drinking Water**

Student performance should be evaluated according to criteria on the assignment sheet.

**Assignment
Sheet 2****Survey Your Area to Identify Water Pollution Sources**

Student performance should be evaluated according to criteria on the assignment sheet.

**Assignment
Sheet 3****Determine Ways to Reduce Water Consumption**

Student performance should be evaluated according to criteria on the assignment sheet.

**Assignment
Sheet 4****Calculate the Cost of Water**

See answer key.

**Assignment
Sheet 5****Calculate and Draw Conclusions From Water Measurements**

See answer key.

**Assignment
Sheet 6****Analyze Current Reports Concerning Water Resource Management**

Student performance should be evaluated according to criteria on the assignment sheet.

Unit 3

Water Resource Management

Objective 19

Assignment Sheet 4—Calculate the Cost of Water— Answer Key

Evaluation Criteria	Rating
• Answers are correct	_____
• Assignment was completed on time	_____

Introduction

Where municipal and rural water systems provide safe, clean drinking water at the turn of a faucet, most consumers pay little thought to the cost of water. Still, purchasing water, filtering and treating it to federal standards, and maintaining its distribution system involves expenses which must be borne by water consumers. This exercise will give you some idea of the cost of water provided by a rural water system to a household of four.

Directions

Read and answer the following questions based on the accompanying water bill.

RURAL WATER CORP. #3 202 S RANGE RD STILLWATER, OK 74075				
ACCOUNT		BILLING DATE		DUE DATE
5512		04/30/03		05/15/03
SERVICE	PRESENT	PREVIOUS	USE	CHARGES
Water	1665324	1648661	16663	64.29
Other Chgs				0.00
Late Fee				0.00
Credit				0.00
Previous Balance				0.00
Please pay by the 15th Disconnect if not paid by 1st of following month (555)551-4064				AMT. DUE 64.29 AFTER DUE DT. 67.50

BEST COPY AVAILABLE

Assignment Sheet 4—Answer Key

1. What is the present meter reading reflected on this bill?

1665324

2. What is the previous meter reading reflected on this bill?

1648661

3. Using the present meter reading and the previous meter reading, is the "use" figure reflected on this bill correct? (Circle the correct response.)

Yes

No

4. Because a water meter measures actual gallons passing through it, use the "use" figure and the total charges for this month's bill to determine how much per gallon this rural water system customer is charged. (Note: Round answer to four decimal places.)

.0039 cents per gallon (\$64.29/16663=.0038582)

5. Using the answer you calculated in question 4, select and circle the answer from the following choices that most closely estimates the number of gallons one penny would buy from this rural water system.

a. 10 gallons

b. 100 gallons

c. 33 gallons

d. 2.5 gallons

(.01/.0039=2.56 gallons)

6. Using a water bill from a local water distribution system in your area, determine how much a customer is charged per gallon of water.

Evaluated according to criteria listed

Objective 20

**Assignment Sheet 5—Calculate and Draw
Conclusion from Water Measurements—
Answer Key**

Evaluation Criteria	Rating
• Calculations are correct.	_____
• Conclusion shows thoughtful consideration and judgment.	_____
• Assignment was completed on time.	_____

Introduction

This exercise is designed to give you practice in calculating water flows and volumes. It is also designed to acquaint you with the minute quantities of pollutants in relation to the water, air, or land around them.

- A. If you ever watch the weather on television, you may remember that part of the weather report includes the total amount of rainfall for the current month, and that number is often compared to the average rainfall per month for that area. This information gives farmers and gardeners an idea as to water distribution per acre from rainfall.

In this assignment you will determine the gallons per acre based on annual rainfall in your area.

Directions

Calculate water measurements using the following procedure.

- Determine the annual rainfall in your area.
- Divide that number by 12 to determine acre-feet.

Note: This will give you the number of feet of rain (acre feet) that fall in your area annually.

- Multiply the acre feet by 326,000 gallons to determine the gallons per acre.

Note: This is the number of gallon in one acre foot.

Assignment Sheet 5—Answer Key

Directions

1. Determine the gallons per acre based on 18" of annual rainfall.

a. Acre feet: 216 (18×12)

b. Gallons per acre: 70,416,000 ($216 \times 326,000$)

2. Determine the gallons per acre based on 52" of annual rainfall.

a. Acre feet: 624 (52×12)

b. Gallons per acre: 203,424,000 ($624 \times 326,000$)

B. News reports carry nearly daily examples of research findings citing alleged health hazards from pollution of water, air, and soil. Usually these reports will cite pollution levels found in increments of parts per million, billion, or trillion.

Using the water measurement figures from the Information Sheets and additional figures given in this assignment, complete the following problems.

1. A flat-bottom municipal swimming pool measures 100 feet by 50 feet and is filled to a depth of four feet. How many gallons does this pool contain?

(Hint) Multiply the length times the width, then multiply that figure times the depth to arrive at the number of cubic feet occupied by the water. Then multiply that number times 7.48 (the number of gallons of water in a cubic foot) to arrive at the answer.

149,000 gallons ($100 \times 50 = 5,000 \times 4 = 20,000 \times 7.48$)

2. The Arkansas River in central Colorado is a prime white water rafting area for thousands of rafters a year. Its flow varies from about 2,000 cubic feet per second during the spring when nearby mountain snows are melting, to about 700 cubic feet per second in the heat of August. If you planned to make a raft trip on the Arkansas and one of the rafting outfitters told you the river's flow was 800 cubic feet per second, how many gallons of water would be flowing across any given point of the river in a second?

a. 5,984 gallons (800×7.48)

Now, imagine that amount of water stored in 55 gallon drums. How many 55 gallon drums would that amount of water involve? (Round up to the nearest drum).

b. 109 55-gallon drums ($5,984/55$)

Assignment Sheet 5—Answer Key

If the average American uses 90 gallons of water per day in household use, how many Americans would a minute's flow of the Arkansas River supply if it were running at 800 cubic feet per second? (Round down to the nearest whole number).

c. **66 Americans** **(5,984/90)**

3. A water quality test shows traces of the herbicide atrazine in your drinking water supply at the level of 1 part per billion. Based on information supplied in Student Supplement 3, would you have reason to be worried over this level of contamination?

Why or why not? **No, because the levels indicated are one-third the maximum contamination level set by the federal government as allowable; however, one would be concerned to know if levels were rising over time.**

4. A television station in your state has surveyed water quality results from a number of towns and has broadcast a story questioning the safety of several water supplies. Your hometown water supply was found to contain the common home garden and agricultural pesticide carbaryl (Sevin) at a level of 200 parts per billion. Given the information on Pesticide Lifetime Health Advisories in Supplement 3, you have reason to worry about your health?

Why or why not? **No, because the level is considered less than government allowances. Still concern would be warranted about the source of pollution and whether the level is rising steady, or falling in magnitude.**

5. Imagine a flat bottom swimming pool as long as a football field (300 feet) and 115 feet wide, filled to a depth of four feet. For ease of computing, let's say that pool contains exactly 1,000,000 gallons of water, although the actual figure is 1,032,240 gallons. One million gallons of water is equivalent to 128 million ounces. Which of the following would most closely amount to one part per million if it were spilled in this giant pool? (Check one)

_____ a. An eight-ounce carton of chocolate milk

_____ **X** b. A one-ounce bottle of perfume roughly the size of a tube of lipstick

Assignment Sheet 5—Answer Key

6. If the example in problem 5 is representative of a part per million, how much smaller would it be to represent a part per billion?

a. 1,000 times smaller

How much smaller would the example in problem 5 have to be to represent a part per trillion?

b. 1,000,000 times smaller

In your opinion, do you think the average television viewer has a realistic idea of the difference between parts per million and parts per trillion?

- c. Why or why not? **Answers may vary and should reflect cognitive grasp of principle.**

Written Test

Name _____

Date _____ Score _____

Objective 1

Match terms related to water resource management with their definitions. Write the corresponding numbers on the blanks provided.

- | | |
|----------------------------|---------------------|
| 1. Aquifer | 7. Hydrologic cycle |
| 2. Ground water | 8. Septic system |
| 3. Ground water recharge | 9. Surface water |
| 4. Hazardous (toxic) waste | 10. Water pollution |
| 5. Hazardous waste site | 11. Watershed |
| 6. Heavy metals | 12. Water vapor |

- _____ a. Continuous circulation of water between the oceans, atmosphere, and the earth's surface
- _____ b. Waste that poses a serious threat to human health, even at low concentrations
- _____ c. Water which seeps through the earth's surface and into ground water aquifers
- _____ d. Water visible on the earth's surface
- _____ e. Water found beneath the earth's surface
- _____ f. Sand, gravel, or rock formation found below the earth's surface which is saturated with water
- _____ g. A waste treatment system used primarily in rural areas
- _____ h. Water which is made chemically, biologically, or physically impure for use
- _____ i. Water which has evaporated and is suspended in the air
- _____ j. The total drainage area where water flows to a common point
- _____ k. Metallic elements with high molecular weights; generally toxic to plant and animal life
- _____ l. A location where hazardous waste poses a potential threat to the environment

Written Test

Objective 2

Select true statements concerning the history of the importance of water in the U.S. Place an "X" in the blanks next to the true statements.

- _____ a. Most organisms can survive without water.
- _____ b. As the United States was settled, the availability of water was of prime concern.
- _____ c. Major population centers are located near major highways.
- _____ d. Industry does not require water.
- _____ e. In general, water was not an important natural resource.

Objective 3

Complete statements concerning water distribution. Write the correct number on the blank provided before each item.

- _____ a. Water covers about _____ percent of the earth's surface.
 - 1) 50
 - 2) 60
 - 3) 70
- _____ b. About _____ percent of the surface water is salt water.
 - 1) 97
 - 2) 67
 - 3) 47
- _____ c. _____ percent of fresh water is contained in underground reservoirs.
 - 1) 25
 - 2) 47
 - 3) 97
- _____ d. Only _____ percent of fresh water in the U.S. exists in streams and lakes.
 - 1) 5
 - 2) 3
 - 3) 2
- _____ e. The volume of ground water that is economically recoverable in the U.S. is equal to _____ times the volume of the Great Lakes.
 - 1) 9
 - 2) 6
 - 3) 3

Objective 4

List four types of water.

- a. _____
- b. _____
- c. _____
- d. _____

Objective 5

Complete statements concerning the hydrologic (water) cycle. Write the correct number on the blank provided before each item.

- _____ a. Water exists in various forms. They are _____
 - 1) Liquid and solid
 - 2) Solid, vapor, and gas
 - 3) Vapor and liquid
 - 4) Liquid, solid, and vapor
- _____ b. The total volume of water on earth _____
 - 1) Changes when it rains
 - 2) Varies according to average annual rainfall
 - 3) Remains constant
 - 4) Is less during a long drought
- _____ c. The hydrologic cycle is _____
 - 1) Water which accumulates after a rain
 - 2) A whirlpool caused by rotating water
 - 3) A vehicle which runs on water
 - 4) Water continuously moving between oceans, atmosphere, and the earth's surface
- _____ d. Water supplies lost to evaporation, runoff, and human use _____
 - 1) Cannot be replaced
 - 2) Are restored by the hydrologic cycle
 - 3) Are insignificant because there is an abundance of water
 - 4) Are replaced by drilling water wells

Written Test

Objective 6

Complete statements concerning surface water by filling in the blanks with the correct words.

- a. Two examples of surface water are _____ and _____.
- b. Surface water must be treated before it can be used for _____ and industrial processes.
- c. Since quantities of surface waters are limited, their use must be _____.

Objective 7

Select true statements concerning ground water by placing an "X" in the blanks next to the true statements.

- _____ a. Ground water is water which is found below the earth's surface.
- _____ b. Ground water exists as lakes and rivers underground.
- _____ c. Half of all Americans and 95% of rural Americans use ground water for drinking water.
- _____ d. Ground water aquifers are sand, gravel, and rock formations.
- _____ e. All ground water is located over 100 feet deep.
- _____ f. Aquifers vary in thickness from a few feet to several hundred feet.
- _____ g. Ground water moves rapidly from a mile to several miles a day.
- _____ h. Ground water, protected by overlying soils, cannot be contaminated.
- _____ i. Ground water resources are unlimited.
- _____ j. Artesian wells are created when aquifer elevations are higher than the top of the well drilled into the aquifer.

Objective 8

Describe the relationship between ground water and surface water.

Written Test

Objective 9	Select true statements concerning water pollution by placing an "X" in the blanks next to the true statements. _____ a. Water pollution has caused serious epidemics such as rabies. _____ b. Rural water wells are often contaminated by livestock and human waste. _____ c. Pollution which can be traced to a point of discharge is called nonpoint source pollution. _____ d. Today water is more likely to be chemically impure rather than biologically impure.
Objective 10	Compare the state of the environment of 1960 and now by placing an "X" in the blanks next to the true statements. _____ a. Surface waters are severely polluted. _____ b. Fish and shellfish are unfit for human consumption. _____ c. Waste discharges from industry are regulated and enforced. _____ d. Funds have been provided from the cleanup of existing hazardous waste sites. _____ e. Wetlands are considered unimportant and are not protected. _____ f. Untreated sewage is dumped into streams and rivers.
Objective 11	Select true statements concerning hazardous/toxic waste by placing an "X" in the blanks next to the true statements. _____ a. Improper hazardous waste disposal is a serious threat to water resources. _____ b. Hazardous waste is generated by petrochemical plants, fertilizer manufacturers, plastic manufacturers, and metal refineries. _____ c. If hazardous waste is placed in dumps and covered with soil, it is safe. _____ d. There are only 10 hazardous waste sites in the U.S. _____ e. Municipal landfills pose no threat to the environment. _____ f. Underground storage tanks are not an environmental problem. _____ g. Chemicals in plastics, solvents, pesticides, paints, and dyes are sources of hazardous waste. _____ h. Health problems associated with hazardous waste contamination include cancer, brain and nerve damage, and birth defects.

Written Test

Objective 12

Match the roles of government agencies and policies to ensure environmental protection of water resources with their intended purposes. Write the corresponding numbers on the blanks provided.

- | | |
|--------------------------|-------------------------|
| 1. Development | 3. Quality assurance |
| 2. Rules and regulations | 4. Environmental damage |

- _____ a. Assure that past environmental damage is cleaned up
- _____ b. Recognize the role of sustainable economic development
- _____ c. Assure safe food, water, and air
- _____ d. Promote or stifle environmental concerns

Objective 13

Select true statements concerning watersheds by placing an "X" in the blanks next to the true statements.

- _____ a. A watershed is where the water starts (source).
- _____ b. Watersheds vary in size.
- _____ c. Water collected in watersheds is carried away by streams or seeps into aquifers.
- _____ d. Land areas where surface water enters ground water aquifers are called springs.
- _____ e. Water pollution is generally caused by human activities on land within the watershed.

Written Test

Objective 14

Match water measurement terms with their definitions or equivalents. Write the corresponding numbers on the blanks provided.

- | | | |
|----------------|---------------|-----------------------|
| 1. Acre foot | 5. GPM | 9. Parts per billion |
| 2. Cubic foot | 6. Kiloliter | 10. Parts per million |
| 3. Cu.ft./sec. | 7. Liter | |
| 4. Gallon | 8. Milliliter | |

- _____ a. 7.48 gallons
- _____ b. Gallons per minute
- _____ c. 1000 milliliters
- _____ d. 1/1000 of a liter
- _____ e. Cubic feet per second
- _____ f. 1 part contaminant per 1 million parts water
- _____ g. 1 foot of water covering one acre
- _____ h. 1 part contaminant per 1 billion parts water

Objective 15

List five career opportunities in water resource management.

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____

*Permission to duplicate this test is granted.

Written Test—Answer Key

Objective 1

Match terms related to water resource management with their definitions. Write the corresponding numbers on the blanks provided.

- | | |
|----------------------------|---------------------|
| 1. Aquifer | 7. Hydrologic cycle |
| 2. Ground water | 8. Septic system |
| 3. Ground water recharge | 9. Surface water |
| 4. Hazardous (toxic) waste | 10. Water pollution |
| 5. Hazardous waste site | 11. Watershed |
| 6. Heavy metals | 12. Water vapor |

- 7 a. Continuous circulation of water between the oceans, atmosphere, and the earth's surface
- 4 b. Waste that poses a serious threat to human health, even at low concentrations
- 3 c. Water which seeps through the earth's surface and into ground water aquifers
- 9 d. Water visible on the earth's surface
- 2 e. Water found beneath the earth's surface
- 1 f. Sand, gravel, or rock formation found below the earth's surface which is saturated with water
- 8 g. A waste treatment system used primarily in rural areas
- 10 h. Water which is made chemically, biologically, or physically impure for use
- 12 i. Water which has evaporated and is suspended in the air
- 11 j. The total drainage area where water flows to a common point
- 6 k. Metallic elements with high molecular weights; generally toxic to plant and animal life
- 5 l. A location where hazardous waste poses a potential threat to the environment

Written Test—Answer Key

Objective 2

Select true statements concerning the history of the importance of water in the U.S. Place an "X" in the blanks next to the true statements.

- ☐ a. Most organisms can survive without water.
- ☒ b. As the United States was settled, the availability of water was of prime concern.
- ☒ c. Major population centers are located near major highways.
- ☐ d. Industry does not require water.
- ☐ e. In general, water was not an important natural resource.

Objective 3

Complete statements concerning water distribution. Write the correct number on the blank provided before each item.

- ☒ 3 a. Water covers about _____ percent of the earth's surface.
 - 1) 50
 - 2) 60
 - 3) 70
- ☒ 1 b. About _____ percent of the surface water is salt water.
 - 1) 97
 - 2) 67
 - 3) 47
- ☒ 3 c. _____ percent of fresh water is contained in underground reservoirs.
 - 1) 25
 - 2) 47
 - 3) 97
- ☒ 2 d. Only _____ percent of fresh water in the U.S. exists in streams and lakes.
 - 1) 5
 - 2) 3
 - 3) 2
- ☒ 1 e. The volume of ground water that is economically recoverable in the U.S. is equal to _____ times the volume of the Great Lakes.
 - 1) 9
 - 2) 6
 - 3) 3

Written Test—Answer Key

Objective 4

List four types of water.

Any four of the following:

- Domestic
- Agriculture
- Industrial
- Business
- Fish and wildlife habitats
- Recreation

Objective 5

Complete statements concerning the hydrologic (water) cycle. Write the correct number on the blank provided before each item.

4 a. Water exists in various forms. They are _____

- 1) Liquid and solid
- 2) Solid, vapor, and gas
- 3) Vapor and liquid
- 4) Liquid, solid, and vapor

3 b. The total volume of water on earth _____

- 1) Changes when it rains
- 2) Varies according to average annual rainfall
- 3) Remains constant
- 4) Is less during a long drought

4 c. The hydrologic cycle is _____

- 1) Water which accumulates after a rain
- 2) A whirlpool caused by rotating water
- 3) A vehicle which runs on water
- 4) Water continuously moving between oceans, atmosphere, and the earth's surface

2 d. Water supplies lost to evaporation, runoff, and human use _____

- 1) Cannot be replaced
- 2) Are restored by the hydrologic cycle
- 3) Are insignificant because there is an abundance of water
- 4) Are replaced by drilling water wells

Written Test—Answer Key

Objective 6

Complete statements concerning surface water by filling in the blanks with the correct words.

- a. Two examples of surface water are _____ and _____. **Any two of the following: Streams, farm ponds, lakes, rivers, oceans, wetland, swamps, and estuaries.**
- b. Surface water must be treated before it can be used for **domestic consumption** and industrial processes.
- c. Since quantities of surface waters are limited, their use must be **conserved**.

Objective 7

Select true statements concerning ground water by placing an "X" in the blanks next to the true statements.

- ☒ a. Ground water is water which is found below the earth's surface.
- ☐ b. Ground water exists as lakes and rivers underground.
- ☒ c. Half of all Americans and 95% of rural Americans use ground water for drinking water.
- ☒ d. Ground water aquifers are sand, gravel, and rock formations.
- ☐ e. All ground water is located over 100 feet deep.
- ☒ f. Aquifers vary in thickness from a few feet to several hundred feet.
- ☐ g. Ground water moves rapidly from a mile to several miles a day.
- ☐ h. Ground water, protected by overlying soils, cannot be contaminated.
- ☐ i. Ground water resources are unlimited.
- ☒ j. Artesian wells are created when aquifer elevations are higher than the top of the well drilled into the aquifer.

Objective 8

Describe the relationship between ground water and surface water.

Descriptions should include the fact that the quality and quantity of one affects the other.

Written Test—Answer Key

Objective 9

Select true statements concerning water pollution by placing an "X" in the blanks next to the true statements.

- ☐ a. Water pollution has caused serious epidemics such as rabies.
- ☒ b. Rural water wells are often contaminated by livestock and human waste.
- ☐ c. Pollution which can be traced to a point of discharge is called nonpoint source pollution.
- ☒ d. Today water is more likely to be chemically impure rather than biologically impure.

Objective 10

Compare the state of the environment of 1960 and now by placing an "X" in the blanks next to the true statements.

- ☒ a. Surface waters are severely polluted.
- ☒ b. Fish and shellfish are unfit for human consumption.
- ☐ c. Waste discharges from industry are regulated and enforced.
- ☐ d. Funds have been provided from the cleanup of existing hazardous waste sites.
- ☒ e. Wetlands are considered unimportant and are not protected.
- ☒ f. Untreated sewage is dumped into streams and rivers.

Objective 11

Select true statements concerning hazardous/toxic waste by placing an "X" in the blanks next to the true statements.

- ☒ a. Improper hazardous waste disposal is a serious threat to water resources.
- ☒ b. Hazardous waste is generated by petrochemical plants, fertilizer manufacturers, plastic manufacturers, and metal refineries.
- ☐ c. If hazardous waste is placed in dumps and covered with soil, it is safe.
- ☐ d. There are only 10 hazardous waste sites in the U.S.
- ☐ e. Municipal landfills pose no threat to the environment.
- ☐ f. Underground storage tanks are not an environmental problem.
- ☒ g. Chemicals in plastics, solvents, pesticides, paints, and dyes are sources of hazardous waste.
- ☒ h. Health problems associated with hazardous waste contamination include cancer, brain and nerve damage, and birth defects.

Written Test—Answer Key

Objective 12

Match the roles of government agencies and policies to ensure environmental protection of water resources with their intended purposes. Write the corresponding numbers on the blanks provided.

- | | |
|--------------------------|-------------------------|
| 1. Development | 3. Quality assurance |
| 2. Rules and regulations | 4. Environmental damage |

- 4 a. Assure that past environmental damage is cleaned up
- 1 b. Recognize the role of sustainable economic development
- 3 c. Assure safe food, water, and air
- 2 d. Promote or stifle environmental concerns

Objective 13

Select true statements concerning watersheds by placing an "X" in the blanks next to the true statements.

- a. A watershed is where the water starts (source).
- X b. Watersheds vary in size.
- X c. Water collected in watersheds is carried away by streams or seeps into aquifers.
- d. Land areas where surface water enters ground water aquifers are called springs.
- X e. Water pollution is generally caused by human activities on land within the watershed.

Written Test—Answer Key

Objective 14

Match water measurement terms with their definitions or equivalents. Write the corresponding numbers on the blanks provided.

- | | | |
|----------------|---------------|-----------------------|
| 1. Acre foot | 5. GPM | 9. Parts per billion |
| 2. Cubic foot | 6. Kiloliter | 10. Parts per million |
| 3. Cu.ft./sec. | 7. Liter | |
| 4. Gallon | 8. Milliliter | |

- 2 a. 7.48 gallons
- 5 b. Gallons per minute
- 7 c. 1000 milliliters
- 8 d. 1/1000 of a liter
- 3 e. Cubic feet per second
- 10 f. 1 part contaminant per 1 million parts water
- 1 g. 1 foot of water covering one acre
- 9 h. 1 part contaminant per 1 billion parts water

Objective 15

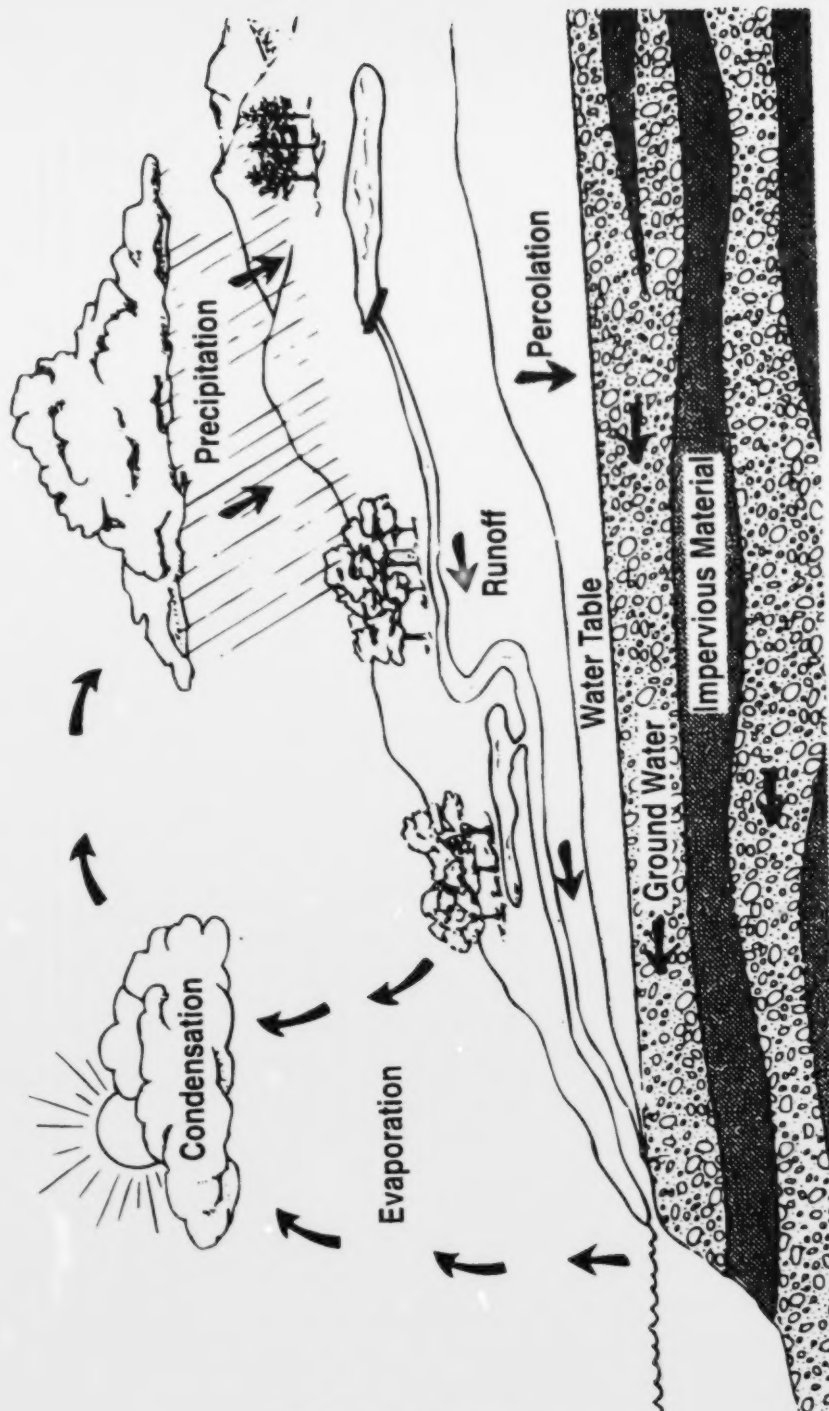
List five career opportunities in water resource management.

Any five of the following:

- Hydrologist
- Chemist
- Geohydrologist
- Soil scientist
- Environmental scientist
- Biologist
- Chemical engineer
- Sanitary engineer
- Agricultural engineer

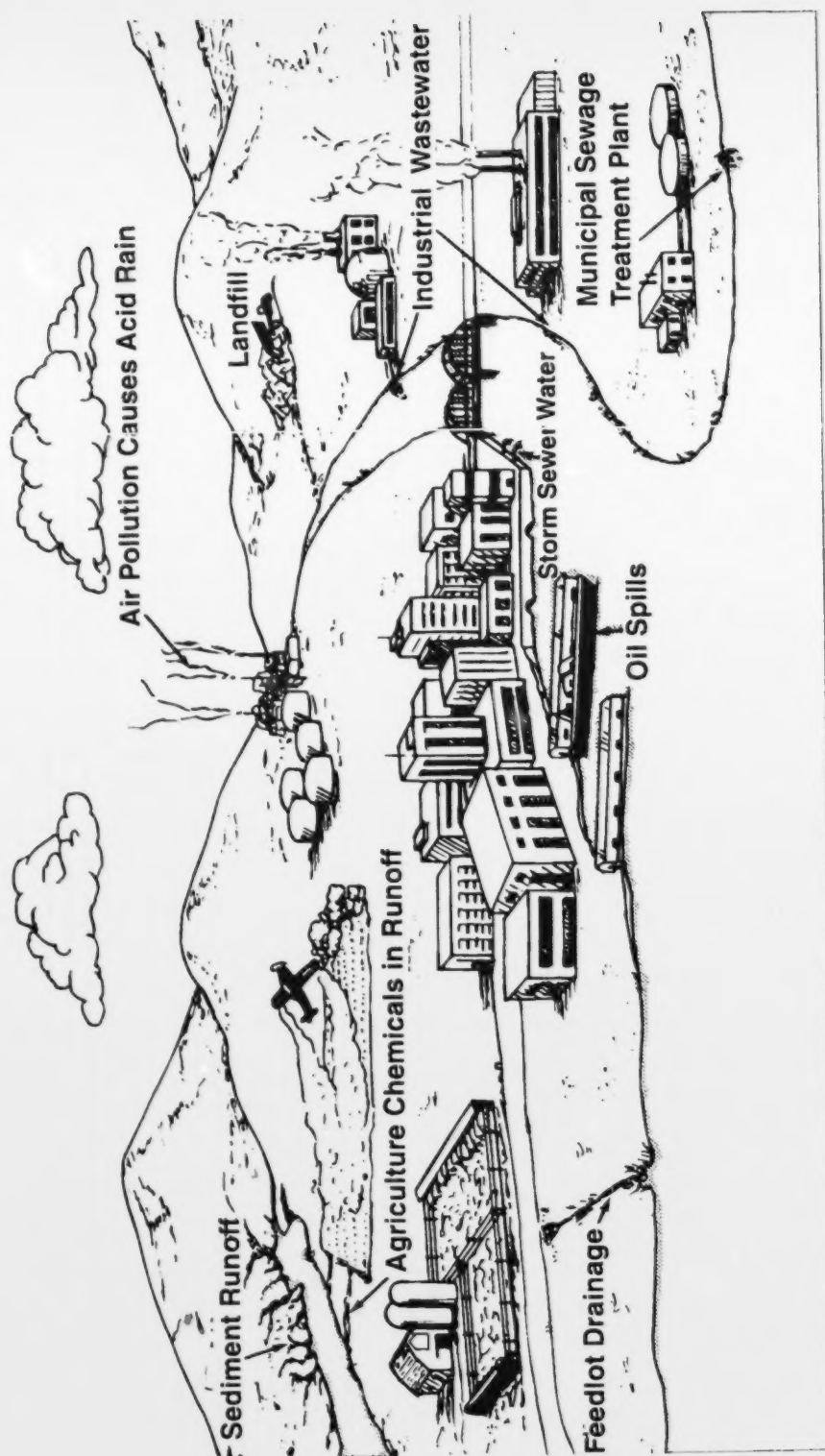
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Hydrologic (Water) Cycle



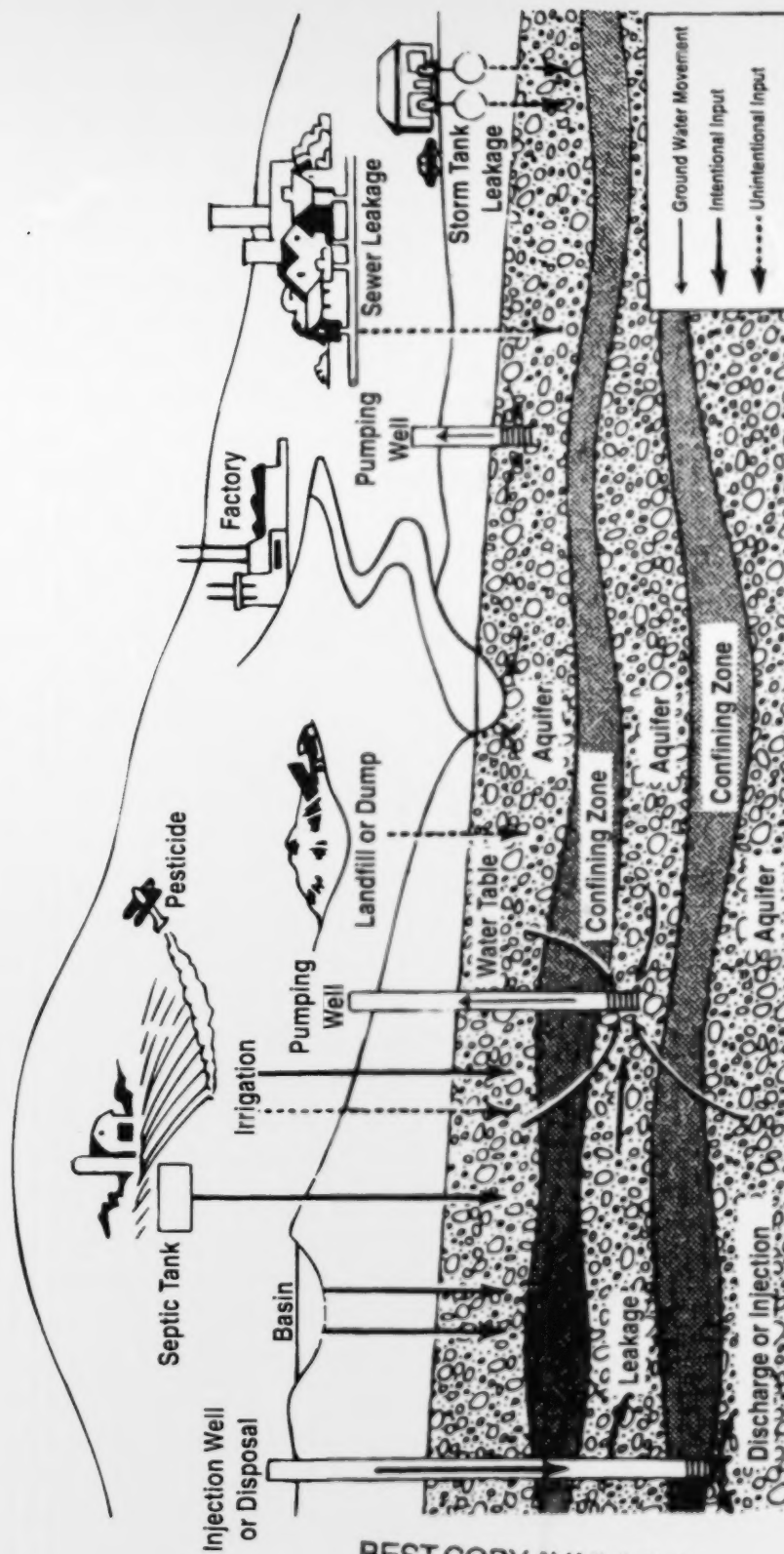
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Surface Water Contamination



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Ground Water Contamination



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Unit 4

Land Management

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Unit Contents

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	5—Read a Soil Survey Map	69
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	7—Complete a Land Use Planning Summary	73
	* Job Sheet	
	1—Take a Lawn and Garden Soil Sample	75
	* Assignment Sheets and Job Sheet are located in the Student Workbook.	

Instructional
Plan

Suggested Activities

Preparation

- Review the objective sheet. Study the specific objectives to determine the order in which you will present the objectives.
- Review the suggested lesson plan. The plan identifies an order for instruction to take place. Each "day" represents a 50-minute class period. The plan is designed to cover the specific objectives over a 15-day period. Additional days and/or activities may be added. (Note: You may want to change days to specific dates. Example: Day 1 may become Monday, November 1, Day 2 = Tuesday, November 2, and so forth.) You will want to localize, supplement, and personalize the plan to fit your situation.
- Review the teaching suggestions included in this instructional plan section to plan classroom activities. Also note the suggestions for supplemental resources.
- Plan your delivery/application to take advantage of student learning styles and to accommodate special needs students.
- Obtain films, videotapes, and other media to supplement instruction of this unit. See "Resources Used in Developing This Unit" and "Suggested Supplemental Resources" for more information.
- Make transparencies or computer presentation from the transparency masters included in this unit. These appear in the teacher edition only and should be used with objectives as indicated below.

TM 1—Composition of Average Soil (Objective 8)

TM 2—Soil Profile (Objective 11)

TM 3—Soil Textures and Their Particles (Objective 12)

TM 4—Controlling Erosion on Farmlands (Objective 27)

TM 5—Controlling Erosion Along Riverbanks (Objective 28)

- Use the following teacher supplements to enhance your delivery and application.

TS 1—Interest Approaches (Introduction, Objectives 2 and 3)

TS 2—Determining Soil Textures Using the Feel Method (Objective 12)

TS 3—Determining Slope (Objective 14)

TS 4—The Effects of Soil Texture, Slope and Ground Cover on Soil Surface Erosion (Objectives 15 to 19 and Objectives 27 to 29)

TS 5—Conduct a Percolation Test (Objective 21)

Suggested Activities

- Use Student Supplement 1—Fertilizer Analysis with Objective 26.
- Select teacher components (written test, unit review, teacher supplements) you want to distribute to your students. Copy and prepare these components for distribution.
- Prepare classroom. Put up posters and charts and display articles and other references related to the objectives of this unit.

Delivery and Application

- Discuss unit and specific objectives.
- Discuss information sheets. Implement teaching plan to localize, supplement, and personalize the unit. Reinforce basic academic and workplace skills when applicable.
- Discuss the assignment sheets and job sheets. Review with students the criteria for evaluation of each of these activities.

Teaching Suggestions

The skill areas appearing in bold-face type in the teaching suggestions refer to the academic and workplace skills identified in *What Work Requires of Schools: A SCANS Report for America 2000* and *Workplace Basics: The Skills Employers Want*. These have been adapted by MAVCC.

- Collect and distribute to the class various types of soil—sand, loam, clay, etc., explain the characteristics of each and accompany your presentation with slides of examples of each found in nature. Invite a geologist or geology teacher to address the class on soil formation and various types of soil erosion. Ask students to give examples of erosion found in your community and have them suggest ways it might be controlled. (**Acquiring scientific information; speaking; listening; applying scientific knowledge; critical thinking**)
- Invite a representative of the Natural Resources Conservation Service to address the class on soil types found in your locale using soil survey maps in use by the NRCS. Have students find their homes or other local landmarks and historical sites on the maps. (**Listening; acquiring scientific information; problem solving**)
- Invite your local land-grant university extension agent to demonstrate the proper techniques for taking soil samples and packaging them for shipping to the university's soils laboratory. Also, suggest the agent review a soil sample results report with the class and show how those results are quantified into recommendations for fertilizer applications. Seek support from the agent for class members' individual or team soil samples called for in Job Sheet 1. (**Listening; acquiring scientific information**)

Suggested Activities

Instructions for Evaluating Student Performance

Evaluation

- Give and evaluate Land Management Review.
- Copy written test and give to students as pretest.
- Evaluate assignment sheets. See the evaluation criteria listed at the top of each assignment sheet. Evaluation may be localized, personalized, or individualized to fit your situation. Record student's grade in your grade book.
- Evaluate job sheet. See the evaluation criteria listed at the top of the job sheet. Evaluation criteria may be localized, personalized, or individualized to fit your situation.
- Give and evaluate written test. Record student's written test score in your grade book and on the student's competency profile.
- Measure competency gains by comparing written pretest scores with posttest scores.
- Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas of improvement.
- Reteach and retest as required.
- When the student is ready to perform a specific task, obtain a copy of the assignment sheet or job sheet which may be found in the student workbook.
- Assignment Sheets — Once the student has completed an assignment sheet, evaluate the student's work using the evaluation criteria. If the student's work is unsatisfactory, have the student review the assignment sheet and submit their work for evaluation again. Record the appropriate level of competency on the student's competency profile.
- Job Sheets - A student may be evaluated for process, product, or both.

Process evaluation—Place a mark in the box to the left of each designated checkpoint if the student has satisfactorily achieved the step(s) for each checkpoint area. If the student is unable to correctly complete the procedure, have the student review the materials and try again.

Product evaluation—Once the student has satisfactorily completed the procedure, rate the student product (outcome) using the criteria which have been provided as part of the job sheet. If the student's product is unacceptable, have the student review the materials and submit another product for evaluation.

Suggested Activities

Resources Used in Developing This Unit

Record the appropriate level of competency on the student's competency profile.

- Sample performance evaluation keys have been provided below. Many other keys are available. Select one rating (grading scale) which best fits your program needs.

Sample A

- 4—**Skilled**—Can perform job with no additional training.
- 3—**Moderately skilled**—Has performed job during training program; limited additional training may be required.
- 2—**Limited skill**—Has performed job during training program; additional training is required to develop skill.
- 1—**Unskilled**—Is familiar with process, but is unable to perform job.
- 0—**No exposure**—No information or practice provided during training program.

Sample B

Yes—Can perform job with no additional training.

No—Is unable to perform job satisfactorily.

- Encourage students to continue their portfolio. The portfolio should become a record of the student's progress in the study of natural resources.

Note: URLs change frequently. Any of the web sites listed may have moved.

- Camp, William G. and Thomas B. Daugherty, *Managing Our Natural Resources* (4th Edition), Albany, NY: Delmar, 2002. www.Agriscience.Delmar.com
- Porter, Lynn, Jasper S. Lee, Diana L. Turner, and J. Malcolm Hillan, *Environmental Science and Technology* (2nd Edition), Danville, IL: Interstate Publishers, Inc., 2003. www.interstatepublishers.com
- Lee, Jasper S., *Natural Resources and Environmental Technology*, Danville, IL: Interstate Publishers, Inc., 2000. www.interstatepublishers.com
- Stiegler, James H., *Land Judging in Oklahoma*, 2001. Manual available online at www.landjudging.com
- Birkenholz, Robert J. and Bryan L. Garton, *Applied Environmental Science*, National Council for Agricultural Education, 1996.
- United States Department of Agriculture, *Farm Bill 2002 – Conservation Provisions Overview*, Washington, D.C. www.usda.gov/farmbill

Suggested Activities

Suggested Supplemental Resources

- U.S.D.A. Natural Resources Conservation Service, Washington, D.C. Web site publications may be ordered or are available in Adobe Acrobat (pdf files). www.nrcs.usda.gov
- Department of Interior, *Energy Policy and Conservation Act Report*, Washington, D.C. Also of special interest on web site are: *Just for Teachers* and *Just for Kids*. www.doi.gov
- Conservation Technology Information Center
1220 Potter Dr., Rm.170
West Lafayette, IN 47906-1383
Phone: 765-494-9555
www.ctic.purdue.edu/CTIC
National non-profit public-private partnership working to promote soil and water quality and equip agriculture with affordable, integrated management solutions.
- Hobar Publications
3943 Meadowbrook Road
Minneapolis, MN 55426-4505
Phone: 1-800-846-7027

Hobar Publications provides a wide variety of materials for agriculture, career, and technology education. Example: Computer software—Soil Evaluation, Fertility, and Related Review. For Apple and IBM. Has questions on soil profile, soil development, land capability, and land use.

- *On American Soil*. ©1985. 28 minutes 16mm or video. Produced by the Conservation Foundation. Discusses soil erosion in America today. Study guide available. Available from:
Bull Frog Films, Inc.
Oley, PA 19547
(800) 543-FROG
www.bullfrogfilms.com
Publisher of independently-produced, environmental videos. Over 500 films available, rental fee involved, ask for catalog.

Suggested Activities

- *All About GPS Technology*, Trimble Navigation Limited, www.trimble.com, 2003

Tutorial on GPS (Macromedia "shockwave player" required to view the tutorial). Tutorial includes:

- Why GPS?
- What is GPS?
- How GPS Works
 - Triangulating; Measuring Distance; Getting Perfect Timing; Satellite Positions; Error Corrections
- Differential GPS
 - Why We Need Differential GPS; How Differential GPS Works; Where to Get Differential GPS; Other Ways to Work with Differential GPS; Advanced Concepts
- Putting GPS to Work
 - Applications; Navigation; Tracking; Mapping; Timing
- Glossary

- *Global Positioning System Primer*, The Aerospace Corporation, www.aero.org/publications/GPSPrimer

Available in .pdf format (1618 KB), may be downloaded for personal or classroom use. If you wish multiple copies (maximum 50) for educational purposes, please send a request on organizational letterhead to:

Public Affairs Department
The Aerospace Corporation
P.O. Box 92957 Mail Stop M1-448
Los Angeles, CA 90009-2957

GPS Primer contents include:

- Welcome to the Global Positioning System (GPS)
- What Is GPS?
- What is Navigation?
- GPS Elements
- Satellites in Space
- Ground Control Stations and Receivers
- How GPS Works - An Amazing System
- Military Uses for GPS
- GPS Uses in Everyday Life
- GPS Related Links

The Aerospace Corporation site also has more information on careers, education, employment, other publications, etc.

Suggested Activities

- *Your Internet Guide to Geographic Information Systems (GIS)*, at www.gis.com

GIS.com is a portal to GIS information on the web and was created by ESRI, a GIS software developer. The site is intended to educate anyone interested in geographic technology on the value that technology brings to their day-to-day activities. The site also provides GIS users with resources to help them with their work.

Contents of site:

- About GIS
 - What is GIS?
 - How to Use GIS
 - How to Do GIS Analysis
 - Why Use GIS?
 - GIS Touches Our Everyday Lives
 - Related Web Sites
- Try GIS for Yourself
 - Links to Live Mapping Sites
 - Submit Your Site
 - Update Your Site
- GIS Software
 - What GIS Software Does
 - Free GIS Software
 - Commercial GIS Software
 - GIS Technology Standards
- Data for Your GIS
 - Using Data in GIS
 - Why Data is Important
 - Data Types and Models
 - Selecting the Right Data
 - Links to Data Sources
- Education and Training
 - The Right Training for You
 - GIS Degree Programs
 - Instructor-Led Training
 - Online Training
 - Self Study
- Additional Resources
 - Associations and Societies
 - Careers in GIS
 - GIS User Groups
 - GIS Books and Periodicals
 - GIS Glossaries
 - GIS Directories
 - Site of the Week
- News/Events/Trends
 - GIS Industry Events
 - GIS Day
 - Recent Articles About GIS

Suggested Activities

- *Oklahoma Land Judging Made Easy*, web site at www.landjudging.com

Site of Annual National Land and Range Contest usually held in April/May in Oklahoma City, OK, each year. Includes information on upcoming contest and pictures of previous contests including teams, score cards, sites, and a movie of the event.

Entire manual *Land Judging in Oklahoma* is available online.

A "quick and dirty" tutorial for land judging is available online, including several judging sites.

Web site includes several land judging field test sites. Also home site judging.

- *The Manual of the National Range Judging Contest: Judging Rangeland for Livestock and Wildlife Values – 4th Edition*, may be viewed on your web browser or as a pdf file at web site www.rangejudging.com

Web site for Annual National Land and Range Contest held each April/May in Oklahoma City, OK

Site includes:

- Rangeland manual
- Plant Characteristics with Images
- Plant Characteristics Quizzes
- Plant Identification Quizzes

- Arrange for students to do their own soil tests. The Redco Science Kit (What's In a Soil) called for in Job Sheet 1 is a relatively inexpensive kit available to schools in quantity. Other kits similar to the Redco kit may also be used, or the services of your state's land-grant university soil lab may be tapped for roughly the same amount.

Available through NASCO on-line catalogs at www.enasco.com.

Suggested Lesson Plan

Day 1

Introduction:

- Review unit objective and review specific objectives and plan for completing this unit.
- Use Teacher Supplement 1—A. Soil vs. Dirt to illustrate what is soil.
- Have students read the introductory statement.
- Discuss the basic concepts that this unit will cover.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 2—Agricultural and non-agricultural uses.
- Use Teacher Supplement 1—B. Uses of Land to discuss statistics and possible questions to answer.
- Discuss Objective 3—Reasons soil is important.
- Use Teacher Supplement 1—C. Changing Land Use Patterns to give students a concept of how they and their families use land every day.
- Discuss Objective 4—How soils are formed.

Closure:

- Review the introductory statement.

Evaluation:

- Non-applicable.

Day 2

Introduction:

- Use Teacher Supplement 1—D. The Apple Demonstration to illustrate the importance of using soil wisely.
- Review Objectives 2–4.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 5—Types of rocks.
- Discuss Objective 6—Weathering factors and their actions.
- Discuss Objective 7—Way soils are deposited.
- Discuss Objective 8—Composition of an Average Soil.
- Use TM 1—Composition of Average Soil to illustrate Objective 8.
- Discuss Objective 9—Functions of organic matter.
- Discuss Objective 10—Major factors that affect land capability classes.

Closure:

- Review Objectives 5–9.

Evaluation:

- Non-applicable.

Suggested Lesson Plan

Day 3

Introduction:

- Review Objective 10.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 11—Horizons of a soil profile.
- Use TM 2—Soil Profile to illustrate horizons.
- Discuss Objective 12—Categories of soil texture.
- Use TM 3—Soil Textures and Their Particles to illustrate the different soil texture.
- Use Teacher Supplement 2—Determining Soil Textures Using the Feel Method to provide students with a hands-on technique for determining soil texture.
- Discuss Objective 13—Categories of soil depth.

Closure:

- Review Objectives 11 and 12.

Evaluation:

- Non-applicable.

Day 4

Introduction:

- Review Objective 13.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 14—Classes of slope.
- Use Teacher Supplement 3—Determining Slope to provide students a technique for measuring changes in elevation.
- Discuss Objective 15—Types of erosion.
- Discuss Objective 16—Causes of erosion.
- Discuss Objective 17—Effects of erosion.
- Discuss Objective 18—Contributors to erosion pollution.
- Discuss Objective 19—Classes of erosion.

Closure:

- Review Objective 14.

Evaluation:

- Non-applicable.

Suggested Lesson Plan

Day 5

Introduction:

- Review Objectives 15–19.
- Use Teacher Supplement 4—The Effects of Soil Texture, Slope and Ground Cover on Soil Surface Erosion to illustrate soil erosion by water.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 20—Types of soil structures.
- Discuss Objective 21—Levels of permeability.
- Use Teacher Supplement 5—Conduct a Percolation Test to illustrate the movement of water in soil.

Closure:

- Review Objective 20.

Evaluation:

- Non-applicable.

Day 6

Introduction:

- Review Objective 21.
- Complete Teacher Supplement 1.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 22—Classes of surface runoff.
- Discuss Objective 23—Land capability classes.
- Have students complete Assignment Sheet 1—Determine Land Capability Classes.
- Turn in Assignment Sheet 1.

Closure:

- Review Objectives 22 and 23.

Evaluation:

- Evaluate student performance on Assignment Sheet 1 according to criteria listed on the assignment sheet.
- Record Assignment Sheet 1 grade in grade book.
- Record the appropriate competency level on each student's competency profile.

Day 7

Introduction:

- Return Assignment Sheet 1 to students and review answers.
- Review terms and definitions from Objectives 2 and 3.
- State the objectives for today's lesson.

Suggested Lesson Plan

Day 8

Delivery and Application:

- Discuss Objective 24—Soil testing.
- Assign Job Sheet 1—Take a Lawn and Garden Soil Sample to be completed at a school site or a student's home.
 - Review evaluation criteria, directions, equipment and materials needed, and the procedures.
 - Assign due date: Day 8.
- Discuss Objective 25—Plant nutrients.
- Discuss Objective 26—Nutrients in a fertilizer analysis.
- Have students read Student Supplement 1—Fertilizer Analysis.
- Discuss Student Supplement 1.
- Have students complete Assignment Sheet 2—Determine Fertilizer Composition and Rates.
- Turn in Assignment Sheet 2.

Closure:

- Review Objective 24.
- Review Job Sheet 1 assignment.

Evaluation:

- Evaluate student performance on Assignment Sheet 2 according to criteria listed on the assignment sheet.
- Record Assignment Sheet 2 grade in grade book.
- Record the appropriate competency level on each student's competency profile.

Introduction:

- Return Assignment Sheet 2 and review answers with students.
- Have students complete Job Sheet 1; assist students in preparing sample for soil testing (in school lab or send to soil testing laboratory); be sure to allow time in a future class to review the soil test report when it is returned from lab.
- Review Objectives 24-26.
- State the objectives for today's lesson.

Delivery and Application:

- Have students complete Assignment Sheet 3—Read a Soil Test Report.
- Turn in Assignment Sheet 3.
- Discuss Objective 27—Controlling erosion on the farm.
- Use TM 4—Controlling Erosion on Farmlands.
- Discuss Objective 28—Methods of controlling non-farm erosion.
- Use TM 5—Controlling Erosion Along Riverbanks.

Closure:

- Review Objectives 24-26.
- Review Assignment Sheets 2 and 3.

Suggested Lesson Plan

Day 9

Evaluation:

- Evaluate student performance on Assignment Sheet 3 according to criteria listed on the assignment sheet.
- Record Assignment Sheet 3 grade in grade book.
- Record the appropriate competency level on each student's competency profile.
- Evaluate student performance on Job Sheet 1 according to criteria listed on the job sheet.
- Record Job Sheet 1 grade in grade book.
- Record the appropriate competency level on each student's competency profile.

Introduction:

- Return Assignment Sheet 3 and review answers with students.
- Return Job Sheet 1 and discuss when you plan to review the soil test.
- State the objectives for today's lesson.
- Review Objectives 27 and 28.

Delivery and Application.

- Discuss Objective 29—Rangeland management.
- Discuss Objective 30—Reclamation of mined lands.
- Discuss Objective 31—Global Positioning System (GPS) and Geographic Information Systems (GIS).
- Assign Assignment Sheet 4—Report on GIS/GPS Technology and Utilization.
 - Review introduction.
 - Review directions.
 - Assign due date: Day 15.
- Provide supervised study for Assignment Sheet 4.

Closure:

- Review Objectives 29 and 30.

Evaluation:

- Non-applicable.

Day 10

Introduction:

- Review Objective 31.
- Review progress on Assignment Sheet 4.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 32—Soil survey reports.
- Have students complete Assignment Sheet 5—Read a Soil Survey Map
- Turn in Assignment Sheet 4.
- Provide supervised study for Assignment Sheet 4.

Suggested Lesson Plan

Day 11

Closure:

- Review Objective 32.

Evaluation:

- Evaluate student performance on Assignment Sheet 5 according to criteria listed on the assignment sheet.
- Record Assignment Sheet 5 grade in grade book.
- Record the appropriate competency level on each student's competency profile.

Introduction:

- Return Assignment Sheet 5 and review answers with students.
- Review progress on Assignment Sheet 4.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 33—Parts of a conservation plan
- Have students complete Assignment Sheet 6—Read a Conservation Plan Map.
- Turn in Assignment Sheet 6.
- Discuss Objective 34—Parts of a land use planning summary.
- Have students complete Assignment Sheet 7—Complete a Land Use Planning Summary.
- Turn in Assignment Sheet 7.
- Provide supervised study for Assignment Sheet 4.

Closure:

- Review Objectives 33 and 34.

Evaluation:

- Evaluate student performance on Assignment Sheet 6 according to criteria listed on the assignment sheet.
- Record Assignment Sheet 6 grade in grade book.
- Record the appropriate competency level on each student's competency profile.
- Evaluate student performance on Assignment Sheet 7 according to criteria listed on the assignment sheet.
- Record Assignment Sheet 7 grade in grade book.
- Record the appropriate competency level on each student's competency profile.

Day 12

Introduction:

- Return Assignment Sheet 6 and review answers with students.
- Return Assignment Sheet 7 and review answers with students.
- Review progress on Assignment Sheet 4.
- State the objectives for today's lesson.

Suggested Lesson Plan

Day 13

Delivery and Application:

- Discuss Objective 35—Stewards of the soil
- Discuss Objective 36—United States Department of Agriculture (USDA) and United States Department of Interior (DOI) roles in land management
- Discuss Objective 37—Career opportunities in land management
- Provide supervised study for Assignment Sheet 4

Closure:

- Review Objectives 35–37

Evaluation:

- Non-applicable

Introduction:

- Review progress on Assignment 4
- Assign written test for Day 14
- State the objectives for today's lesson

Delivery and Application:

- Have students complete Land Management Review
- Turn in Land Management Review
- Provide supervised study for Assignment Sheet 4 or review for written test

Closure:

- Remind students of written test on Day 14
- Remind students that Assignment Sheet 4 is due on Day 15

Evaluation:

- Evaluate student performance on Land Management Review according to criteria listed.
- Record Land Management Review grade in grade book.

Day 14

Introduction:

- Return Land Management Review and review answers with students.
- State the objectives for today's lesson.

Delivery and Application:

- Give written test.
- Turn in written test.
- Provide supervised study for students to complete Assignment Sheet 4.

Closure:

- Remind students that Assignment Sheet 4 is due on Day 15.
- Remind student to be prepared to discuss their research.

Suggested Lesson Plan

Day 15

Evaluation:

- Evaluate written test.
Note: Develop teaching strategies for students who did not achieve the minimum score.
- Record written test grade in grade book.
- Record written test score on each student's competency profile.

Introduction:

- Return written test and review answers with students.
- Discuss strategies for students who did not meet minimum score.
- Remind students that Assignment Sheet 4 is due.
- State the objectives for today's lesson.

Delivery and Application.

- Have students discuss their research findings from Assignment Sheet 4.
- Turn in Assignment Sheet 4.

Closure:

- Review highlights of Land Management unit.
- Review next lesson.

Evaluation:

- Evaluate student performance on Assignment Sheet 4 according to criteria listed on the assignment sheet.
- Record Assignment Sheet 4 grade in grade book.
- Record the appropriate competency level on each student's competency profile.

Land Management Review

Name _____ Overall Rating _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate serious effort was taken in completing review	_____

Introduction

The soil is one of the most important natural resources. It is important that we use it wisely and conserve it for future generations. The land management practices we practice on agricultural and non-agricultural uses will determine our future.

Directions

Answer the following questions concerning land management. For help, refer to the information sheets and student supplements found in this unit. Circle the correct response for each question.

1. _____ is the planning and implementation of practices applied to the land.
 - a. Land use
 - b. Land management
 - c. Land use summary
 - d. Soil survey
2. _____ is the outer portion of the earth's crust that supports plant life.
 - a. Land
 - b. Dirt
 - c. Soil
 - d. Organic matter
3. _____ is the relative proportion of sand, silt, and clay particles in a specific soil mass.
 - a. Soil profile
 - b. Soil structure
 - c. Permeability
 - d. Soil texture

Review

4. _____ is the study of physical features (natural and man-made) on the land's surface.
 - a. Topography
 - b. Surface runoff
 - c. Slope
 - d. Soil profile
5. _____ is the actions that break down rock into soil.
 - a. Erosion
 - b. Weathering
 - c. Contour
 - d. Reclamation
6. Which of the following is an example of agricultural land use?
 - a. Highways and roads
 - b. Airports
 - c. Pasture for hay and grazing
 - d. Wildlife areas
7. Soil provides a home to many microorganisms. This reason why soil is important is called:
 - a. Plant growth
 - b. Waste disposal
 - c. Aesthetics
 - d. Habitat for microbes
8. _____ break down the organic matter into simpler nutrients that are released into the soil, further aiding plant growth.
 - a. Weathering factors
 - b. Rock particles
 - c. Bacteria and fungi
 - d. Man-made machines
9. _____ is formed by hardening of molten volcanic materials.
 - a. Glacial soil
 - b. Igneous rock
 - c. Metamorphic rock
 - d. Sedimentary rock

Review

10. The weathering factor that breaks down rock into soil by using the expansion of frozen water is called:
 - a. Glaciers
 - b. Ice
 - c. Temperature changes
 - d. Chemicals
11. _____ are soils deposited by wind.
 - a. Glacial soils
 - b. Sandy soils
 - c. Loess soils
 - d. Alluvial soils
12. The composition of an average soil is:
 - a. Mineral matter—50%; Water—20%, Air—20%, and Organic matter—10%
 - b. Mineral matter—25%; Water—25%, Air—25%, and Organic matter—25%
 - c. Mineral matter—5%; Water—25%, Air—25%, and Organic matter—45%
 - d. Mineral matter—45%; Water—25%, Air—25%, and Organic matter—5%
13. A function of organic matter is to:
 - a. Store oxygen for plant growth.
 - b. Provide food for soil microorganisms.
 - c. Make soil less tillable and to destroy plant life.
 - d. Return hazardous waste to the soil.
14. A major factor that may keep land from being classified as Class I is:
 - a. Erosion
 - b. Structure
 - c. Mineral matter
 - d. Topography
15. When studying soil horizons, parent material is:
 - a. Plant and animal matter in various stages of decay; O Horizon.
 - b. Humus, roots, organisms; A Horizon.
 - c. Fine particles, leached materials, some roots; B Horizon.
 - d. Weathered bedrock and some leached materials; C Horizon.

Review

16. When moist soil is squeezed between thumb and forefinger, it crushes with some effort. It will form a short well-formed ribbon with a shiny surface which will tend to break or the ribbon will bend downward. The soil texture of this soil is:
 - a. Fine-textured
 - b. Moderately fine-textured
 - c. Medium-textured
 - d. Moderately coarse-textured
17. The total thickness (depth) of the top soil and subsoil is 15 inches. The category of soil depth is:
 - a. Deep
 - b. Moderately deep
 - c. Shallow
 - d. Very shallow
18. A field has an elevation change of $4\frac{1}{2}$ feet. This slope may be classified as:
 - a. Nearly level
 - b. Gently sloping
 - c. Moderately sloping
 - d. Strongly sloping
19. The original top soil of a field measured 12 inches. Six inches the of top soil remains. There are small rills and a crossable gully present. The erosion in this held would be classified as:
 - a. None to slight
 - b. Moderate
 - c. Severe
 - d. Very severe
20. A soil's structure appears to be sphere-like with no flat surfaces. This appearance is due to contact pressure from the faces of surrounding aggregates. This type of soil structure is called:
 - a. Blocky
 - b. Granular
 - c. Prismatic
 - d. Columnar

Review

21. A sub soil is very firm when moist and very firm when dry. Roots are few and generally follow ped faces and cracks. The level of permeability of sub soil is:
- a. Rapidly permeable
 - b. Moderately permeable
 - c. Slowly permeable
 - d. Very slowly permeable
22. When observing the surface runoff in a field, you determine that water flows away so slowly that free water covers the soil for moderate periods. This class of surface runoff is:
- a. Rapid
 - b. Moderate
 - c. Slow
 - d. Very slow
23. You observe a field. It is nearly level, well to moderately-well drained, deep, medium textured, not subject to erosion or flooding, and easily cultivated. The land appears to be very productive and cultivated with minimal erosion control measures. The land capability class would be:
- a. Class I
 - b. Class II
 - c. Class III
 - d. Class IV
24. You observe another field. It is nearly level, deep, and medium textured. The field has little or erosion hazard, but it may be in a frequent flood plain. The land capability class would be:
- a. Class II
 - b. Class III
 - c. Class V
 - d. Class VII
25. A _____ will estimate the amount of nutrients a soil can provide to a plant.
- a. Soil test
 - b. Soil survey
 - c. Land use summary
 - d. Conservation plan

Review

26. _____ is a major plant nutrient.
- a. Calcium
 - b. Iron
 - c. Nitrogen
 - d. Magnesium
27. _____ is the second nutrient represented in a fertilizer analysis.
- a. Nitrogen (N)
 - b. Potassium (K)
 - c. Iron (Fe)
 - d. Phosphorus (P)
28. _____ is a technique to use to control erosion on the farm.
- a. Farming in straight rows up and down hills
 - b. Leaving a minimum of 5% of the previous year crop's residue on the soil surface after planting
 - c. Overgrazing of pastures and rangelands
 - d. Planting windbreaks to slow wind speeds
29. _____ is a method to control non-farm erosion.
- a. Removing vegetation on the soil as soon as possible after harvest
 - b. Leaving grass seed on bare soil until it sprouts
 - c. Planting grass and ground covers
 - d. Removing trees from perimeter of a construction area
30. In the Southwestern United States as much as _____ of the land is considered rangeland.
- a. 20%
 - b. 50%
 - c. 60%
 - d. 85%
31. Because of erosion problems, surface strip-mines are required to have a _____
- a. Soil survey
 - b. Land use plan
 - c. Reclamation plan
 - d. Soil map

32. The Global Positioning System (GPS) is:
- a. Designed for the collection, storage, and analysis of objects and phenomena where geographic location is an important characteristic or critical in the analysis.
 - b. A network of satellites that are designed to help ground based units determine their current location in latitude and longitude coordinates.
 - c. A system managed by the U.S. Department of Defense for military use only.
 - d. A map overlay system used to predict crop production.
33. The systematic examination, description, classification, and mapping of soils in an area is called a:
- a. Soil profile
 - b. Soil survey
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34. A role of the United States Department of Agriculture (USDA) is:
- a. To act as the steward and guardian of our nation's natural resources and cultural heritage.
 - b. To implement legislation and provide resources toward conservation on private lands.
 - c. To manage public lands owned by the federal government.
 - d. To manage the National Park Service and the U.S. Fish and Wildlife Service.

Land Management Review—Answer Key

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate serious effort was taken in completing review	_____

1. _____ is the planning and implementation of practices applied to the land.
 - a. Land use
 - b. Land management**
 - c. Land use summary
 - d. Soil survey
2. _____ is the outer portion of the earth's crust that supports plant life.
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 - b. Dirt
 - c. Soil**
 - d. Organic matter
3. _____ is the relative proportion of sand, silt, and clay particles in a specific soil mass.
 - a. Soil profile
 - b. Soil structure
 - c. Permeability
 - d. Soil texture**

Review—Answer Key

4. _____ is the study of physical features (natural and man-made) on the land's surface.
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 - b. Surface runoff
 - c. Slope
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9. _____ is formed by hardening of molten volcanic materials.
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 - d. Weathered bedrock and some leached materials; C Horizon.**

Review—Answer Key

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Review—Answer Key

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- a. Designed for the collection, storage, and analysis of objects and phenomena where geographic location is an important characteristic or critical in the analysis.
 - b. A network of satellites that are designed to help ground based units determine their current location in latitude and longitude coordinates.**
 - c. A system managed by the U.S. Department of Defense for military use only.
 - d. A map overlay system used to predict crop production.
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- a. To act as the steward and guardian of our nation's natural resources and cultural heritage.
 - b. To implement legislation and provide resources toward conservation on private lands.**
 - c. To manage public lands owned by the federal government.
 - d. To manage the National Park Service and the U.S. Fish and Wildlife Service.

Teacher Supplement 1—Interest Approaches

Materials Needed

A. Soil vs. Dirt

- 2 bowls
- Two types of soil

Procedure

Pass two bowls of soil around the class and ask students what they think the soil is. Prompt students to refer to it as soil rather than dirt. If the soils are different, explain that soils can be and are different all over the world.

Leading questions to ask while students are observing the soil samples.

- What is this (in the bowls)?
- What is in soil?
- Can you or I make soil?
- Is soil valuable?
- If we are going to learn about soil what do we need to learn?

B. Uses of Land

Lead students in discussing various uses of land and the possible implications of uses.

Statistics

- Total acres in U.S. — 2,271,600,000 acres
- All usable crop land — 413,000,000 acres
- Crop land in use — 313,400,000 acres
- Forest land — 749,628,000 acres
- Grazing land — 730,000,000 acres
- Urban land — 130,000,000 acres

Possible questions to answer if we want to understand land management

1. How is land defined?
2. How do we use land?
3. What are some past and present uses of land?
4. What do we need to know about soil so that we can understand how to best use and conserve it?
5. What is land use planning? Why is it important?
6. What are some considerations and/or techniques that should be used when planning land uses?

Teacher Supplement 1

C. Changing Land Use Patterns

This activity should give students a concept of how they and their families use land every day.

Changing land use patterns within the local community often provides an appropriate topic of study and may be useful in developing a student's understanding of land management.

Each 100 families that are added to a community require approximately 100 acres of private land, 4 acres of public land, 4 classrooms, 40,000 gallons of water/day, and 15,000 feet of streets. As a community grows the uses of land surrounding the community increases in intensity, acreage, and variability.

- Have students examine how their community has changed in size, population, types of businesses, and urbanization (streets, sidewalks, etc.). Discuss non-farm uses and their affect on their community.

D. Apple Demonstration

Source

www.landjudging.com

The following demonstration helps us understand the small portion of earth capable of producing food and emphasizes the importance that each generation use the soil wisely.

Materials Needed

- 1 apple
- knife

Procedure

1. Cut the apple into four equal parts.
Three parts represent the oceans of the world. The fourth represents the land area.
2. Cut the land section in half lengthwise.
Now you have two one-eighth pieces. One section represents the deserts, swamps, mountainous, arctic, and antarctic regions of the world. The other one-eighth represents land where man can live but cannot grow food.
3. Cut this one-eighth section crosswise into four equal parts.
Three of these one thirty-second sections represent the areas of the world, which are either so rocky, wet and hot, or contain soil so poor that food production is not possible.
4. Carefully peel the last one thirty-second section.
This small bit represents the soil of our earth that all of us depend on for food!

**Teacher Supplement 2—Determining Soil Textures
Using the Feel Method****Purpose**

Determine soil texture by using hands and the ribbon test method.

**Materials
Needed**

- Soil samples—from gardens, lawns, fields, parks, etc. (Clay, loam, and sand)
Note: Place each sample in a separate container and number the container
- Water
- Towels or rags

Procedure

1. Obtain a soil sample (handful is enough).
2. Place a small amount of soil in your palm.
3. Add water one drop at a time and knead the soil to break down all aggregates.
Note: Soil should only be moist, not saturated. Soil is at its proper consistency when plastic and moldable, like moist putty.
4. Work through *Feel Method to Determine Soil Texture* following the directions.
5. Determine the soil texture of the sample and record on Soil Texture Chart.

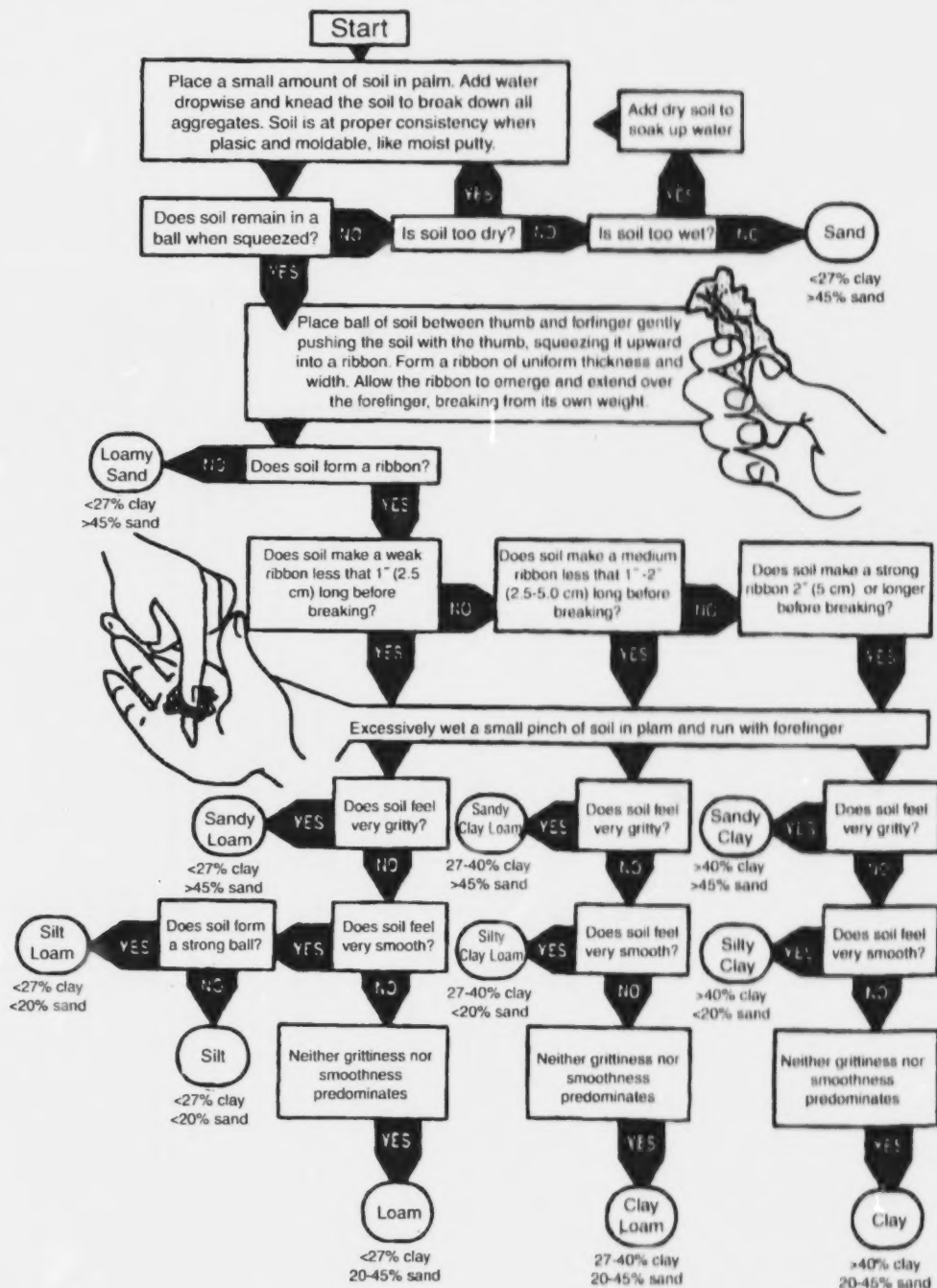
Soil Sample Number	Soil Texture

6. Compare results with fellow students.

Note: Another resource for determining soil texture is the land judging manual available at www.landjudging.com.

Teacher Supplement 2

Feel Method to Determine Soil Texture



Source: Applied Environmental Science National Council for Agriculture Education

Teacher Supplement 3—Determining Slope

Purpose	To illustrate a way to determine the change in elevation (slope) of a field or landscape.
Materials Needed	• 100" board (2" x 6" board works best) • Tape measure • Level
Procedure	1. Select various slopes in an area. Examples: Around your school, in a field or pasture, where structures are being built 2. Place one end of the 100" board on the slope you want to measure. 3. Hold board outright so it is level. Note: Place a level on the outright board. Raise or lower board until it is level. 4. Measure the number of inches the free end of the board is off the ground. 5. The number of inches is the slope of the land in percent. Example: 5" = 5% (5 inches of rise or fall in 100 inches of length) 6. Repeat the above steps in several different areas to get an average slope of the land being investigated.
Questions that Might be Asked	• Is there a problem with erosion due to too much slope? • Is there a problem with drainage due to too little slope? • What are some suitable uses of the land considering the slope?
Alternative Method	• Repeat the process using a 50" board and multiply the measurements by 2 to determine the percent of slope.

Teacher Supplement 4—The Effects of Soil Texture, Slope and Ground Cover on Soil Surface Erosion

Purpose

To analyze the concept of soil surface erosion and the susceptibility of different soil textures, slope, and ground covers to erosion.

Materials Needed

- Six aluminum loaf pans
- Six clear glass jars of consistent size (pint preferred)
- Sprinkling can for water
- Tin snips or similar cutting tool to cut aluminum
- Labels or tape that will stick to aluminum pans and glass jars
- Water
- Measuring container (quart jar will work)
- Inclined surface with braces
- Residue cover (leaves, grass clippings, or other crop residue)
- Measuring device (ruler, tape measure)
- Six soil samples (Two samples to represent each soil texture group — clay, loam, and sand)

Procedure

1. Use tin snips and make a V-shaped notch in one end of each of the six aluminum loaf pans to permit surface water to drain.
2. Place each of the soil samples in a separate loaf pan. There will be two loaf pans for each of the soil textures - clay, loam, and sand.
3. Place the residue cover on one sample of each of the soil textures.
4. Number and label each pan (using labels or tape) with the contained soil texture and cover.
Example: Pan #1: clay soil – no cover, Pan #2: clay soil – cover, Pan #3: loam soil – no cover, Pan #4: loam soil – cover, Pan #5: sand soil – no cover, and Pan #6: sand soil – cover
5. Number and label each of the six glass jars to match a pan number.
6. Use the measuring device to set up an inclined surface with the desired slope i.e. 2%, 4%, etc.
Note: Divide the height of the elevation by the length of the pan and multiply by 100 to determine percentage of slope.
Example: Assume a loaf pan is 12 inches long. A 1/4 inch incline would be a 2% slope. ($0.25/12 = .021 \times 100 = 2.1\%$)
7. Secure the pans to the inclined surface with the V-notch at the lower end. All six of the pans should have the same incline.
8. Place one of the clear glass jars the end of each of the pans (with the V-notch) to collect the runoff water.

Teacher Supplement 4

9. Form your hypotheses:

- a. Which soil sample and cover will produce the least amount of soil erosion?

Hypotheses 1: _____

- b. Which soil sample and cover will produce the greatest amount of soil erosion?

Hypotheses 2: _____

10. Measure an amount of water (suggest one quart) and pour in sprinkler can.
11. Use the sprinkler can and pour on the soil sample in the pan labeled #1. Note the amount of water and height from which the water was poured.
12. Collect the surface runoff in the jar (labeled for pan #1) and note the amount of erosion that takes place.
13. Record your observations on the data and observation chart.
14. Repeat steps 9, 10, 11, and 12 for the remaining five samples. Be sure to fill the sprinkler can with the same amount of water and position it at the same height as the first pan.

Data and Observation Chart

Soil Sample	Record of Observation
Pan #1: Clay Soil – No Cover	
Pan #2: Clay Soil – Cover	
Pan #3: Loam Soil – No Cover	
Pan #4: Loam Soil – Cover	
Pan #5: Sand Soil – No Cover	
Pan #6: Sand Soil – Cover	

Teacher Supplement 4

15. Review hypothesis 1 and 2 and accept or reject. Explain your answer.

Note: Circle your response.

a. Hypothesis 1: Accept Reject

Explanation: _____

b. Hypothesis 2: Accept Reject

Explanation: _____

Instructor

- Consider repeating this experiment using a different change in elevation (slope).
- Be sure to practice this experiment before presenting to class.
- An alternative to this experiment would be to use three loaf pans:
 - fill all three pans with the same soil texture
 - Pan #1: no cover, bare soil
 - Pan #2: terrace
 - Pan #3: cover
 - Determine desired slope
 - Repeat steps 9–12
 - Illustrates affect of terracing and cover crops on soil erosion

Teacher Supplement 5—Conduct a Percolation Test**Purpose**

To conduct a soil percolation test and understand its use.

Permeability has been defined as the movement of air and water through the soil. Percolation may be defined as the movement of water through the soil. The rate at which water percolates through soil affects its uses. Uses that are affected by percolation rate include: crop production, suitability for construction, and sewage effluent disposal. In addition, the frequency of flooding in an area is affected by the percolation rate of soil. Percolation tests are designed to precisely determine the rate water percolates through the soil.

Materials Needed

- Post-hole digger or auger
- Measuring stick (approximately 6' long)
- Black marker for marker for measurements
- Cloth for drying water off of the measuring stick
- Fine gravel or coarse sand
- 2" X 8" board three feet long
- Tape measure
- Water

Procedure

1. Locate a field where holes can be bored.
2. Dig or bore six or more test holes 4" to 12" in diameter and about 5 feet deep.
Note: Be sure holes are evenly distributed throughout the field.
3. Roughen the sides of each hole to remove any smeared or slickened surface that would interfere with water entering the soil.
4. Remove any loose soil from the bottom of the holes.
5. Add 2" of fine gravel or coarse sand to prevent sealing by puddling
Note: Puddling is the intermixing of sand, silt, and clay resulting in compaction.
6. Pour at least 12" of water in each hole.
7. Add water, as needed, to keep the water level 12" above the gravel for at least four hours.
Note: Preferably overnight during dry periods. If percolation tests are made during a dry season, the soil must be thoroughly wetted to simulate its condition during the wettest season of the year before the percolation rate is measured. The results should be the same regardless of the season.

Teacher Supplement 5

8. When ready to take final measurements adjust the water level to about 6" above the gravel in the bottom of the hole.

Note: Be sure to use the 2" x 8" board as a fixed point of reference and mark the measuring stick where it crosses the board.

9. Use the measuring stick to measure the drop in water level over a thirty-minute period.

Note: Be sure to dry the measuring stick between measuring to insure accurate measurements.

10. Multiply the measurement of the drop in water level by two (2) to calculate the inches of percolation per hour.

11. Record the drop in water level the area of the field where the hole is located.

12. Repeat the procedure for all the test holes and average the percolation rate to calculate the average percolation rate for the field.

Field Name _____

Example: Hole 1: percolation 2 inches/hour Area: Northeast corner of field

Hole 1: _____ Area: _____

Hole 2: _____ Area: _____

Hole 3: _____ Area: _____

Hole 4: _____ Area: _____

Hole 5: _____ Area: _____

Hole 6: _____ Area: _____

Questions that could be asked

- What is the average percolation of the test holes in the field?
- What are some suitable uses for this field?
- What are some uses this field should not be used for?
- How does the percolation test show suitable uses for the soil?
- How does soil percolation rate pertain to water quality?

Answers to Assignment Sheets**Assignment
Sheet 1****Determine Land Capability Classes**

See answer key.

**Assignment
Sheet 2****Determine Fertilizer Composition and Rates**

See answer key.

**Assignment
Sheet 3****Read a Soil Test**

See answer key.

**Assignment
Sheet 4****Report on GIS/GPS Technology and Utilization**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 5****Read a Soil Survey Map**

See answer key.

**Assignment
Sheet 6****Read a Conservation Plan Map**

See answer key.

**Assignment
Sheet 7****Complete a Land Use Planning Summary**

See answer key.

Assignment Sheet 1—Determine Land Capability Classes—Answer Key

Evaluation Criteria	Rating
• Directions have been followed	_____
• Soil factors were identified	_____
• Land capability classes were determined	_____

Directions

Using the information provided for each of the following fields, determine the land capability class for each field.

- Write the appropriate category for each soil factor in the blanks provided. Examples: Texture Medium; Depth Deep; and so forth.
- Determine the land capability class and write in the blank provided

Note: Refer to Objectives 12 through 23 for additional information or clarification.

Field #1: Characteristics include :

- Texture: soil feels gritty but contains enough silt and clay to make moist soil hold together
- Depth: over 40 inches
- Slope: 2 feet elevation change
- Erosion: shows no obvious effect of erosion
- Permeability: subsoil is friable to very friable with large pores
- Surface runoff: water drains away readily but yet slow enough that a large amount of water enters the soil

Texture Moderately Course Erosion None to Slight

Depth Deep Permeability Moderately

Slope Gently Sloping Surface Runoff Moderate

Land Capability Class II

Assignment Sheet 1—Answer Key

Field #2: Characteristics include:

- Texture: soil is loose, very friable and the individual grains can be readily seen or felt
- Depth: 30 inches
- Slope: 9 feet elevation change
- Erosion: original top soil was 16 inches; current top soil is 4 inches; has a large uncrossable gully
- Permeability: subsoil tends to be very friable or loose when moist
- Surface runoff: water is removed from soil surface at a rapid rate

Texture Course Erosion Moderate

Depth Moderately Deep Permeability Moderately

Slope Moderately Sloping Surface Runoff Rapid

Land Capability Class III

Field #3: Characteristics include:

- Texture: soil breaks into clods or lumps when dry; it will form a short well-formed ribbon with a shiny surface
- Depth: over 40 inches
- Slope: less than 1 foot elevation change
- Erosion: less than 25% of top soil has been removed; no gullies are present
- Permeability: subsoil is firm when moist and firm when dry
- Surface runoff: water flows away so slowly that free water covers the soil for moderate periods
- Other: field is in a frequent flood plain

Texture Moderately Fine Erosion None to Slight

Depth Deep Permeability Slowly

Slope Nearly Level Surface Runoff Slow

Land Capability Class V

Assignment Sheet 1—Answer Key

Field #4: Characteristics include:

- Texture: Soil has a slightly smooth or velvety feel when moist
- Depth: 35 inches
- Slope: 4 feet elevation change
- Erosion: 40% of original top soil present; two crossable gullies are present
- Permeability: subsoil is friable to very friable with large pores; roots are present
- Surface runoff: water is removed from the soil surface at a rapid rate

Texture Medium

Erosion Moderate

Depth Moderately Deep

Permeability Moderately

Slope Moderately Sloping

Surface Runoff Rapid

Land Capability Class III

Assignment Sheet 2—Determine Fertilizer Composition and Rates—Answer Key

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers are correct	_____
• Assignment was completed on time	_____

Directions

After reviewing Student Supplement 1, answer the following questions concerning fertilizer composition and rates.

- Identify and record the proper percentages of plant nutrients in the following fertilizer blends.

- 18-46-0 18% N; 46% P; 0% K
- 33-0-0 33% N; 0% P; 0% K
- 35-10-11 35% N; 10% P; 11% K
- 0-0-24 0% N; 0% P; 24% K
- 10-20-10 10% N; 20% P; 10% K

Assignment Sheet 2—Answer Key

2. Determine the number of pounds of the given plant nutrient in 2000 lbs. of the following fertilizer blends.
- a. 15-30-15 (Phosphorus) 600 (200 x .30) lbs.
- b. 82-0-0 (Nitrogen) 1640 (2000 x .82) lbs.
- c. 17-17-17 (Sulfur) 0 lbs.
- d. 5-10-5 (Potassium) 100 (2000 x .05) lbs.
- e. 18-46-0 (Potassium) 0 lbs.
3. Read the following scenarios and answer accordingly.
- a. A soil test shows you need only nitrogen at the rate of 100 lbs. per acre to maintain the grass on a one-half acre park you are maintaining. If the only fertilizer you have is a 5-10-5 blend, how many lbs. of fertilizer will you need to apply to the park to achieve the 100 lbs. per acre rate of nitrogen?
- 1000 lbs. (100/.05 = 2000/2)
- b. If you could use ammonium nitrate (33-0-0), how many lbs. of fertilizer will you have to use to apply 100 lbs. per acre to the park?
- about 150 lbs. (100/.33 = 303/2)
- c. If ammonium nitrate cost \$200 per ton (2,000 lbs.), how much would your fertilizer application cost?
- \$15.00 (200/2000 = .10 x 150)
- d. If you used the 5-10-5 blend and it cost \$7 per 50 lb. sack, how much would your fertilizer application cost?
- \$140.00 (1000/50 = 20 x \$7)
- e. How much could you save by using ammonium nitrate instead of the 5-10-5 blend?
- \$125.00 (140 - 15)
4. If you were paying for the fertilizer application in question 3, which fertilizer would you use? Why?
- Ammonium Nitrate** (answer could include: fertilizer cost is less; apply only the fertilizer needed — nitrogen)

Assignment Sheet 2—Answer Key

5. A midwest corn grower wants to plant a 100 acre field. A soil sample analysis from a reputable soil testing laboratory indicates she needs 100 lbs. of actual nitrogen per acre and no additional phosphorus or potassium for optimum corn production. Based on the following fertilizers available to her, which would represent the most cost-effective choice if application costs are all equal? (Circle your response)
- a. 18-46-0 at \$150 per ton
 - b. 33-0-0 at \$200 per ton
 - c. 82-0-0 at \$250 per ton

6. Why do you think farmers would be unwise to fertilize by guessing at application rates versus spending \$6 to \$12 on a calibrated soil test to determine recommended rates?

Evaluated to satisfaction of instructor. Answer could include: applying only the nutrient needed; applying nutrients that are not needed is wasteful and expensive

7. As spring gets underway and lawns begin to green up, a homeowner sees an advertisement from a lawn and garden store featuring 40 lb. sacks of 5-10-5 lawn fertilizer for \$4.00 each. The local feed dealer is not having a sale, but sells 10-20-10 fertilizer everyday for \$6 per 50 lb. sack. Assuming the homeowner's lawn needs a total of 20 lbs. of actual nitrogen and can use the P and K in each of the blends, which is the best buy? Why?

The 10-20-20 because it costs only \$12 to accomplish the goal. The 5-10-5 would cost \$16.

8. If a Missouri rancher has access to chicken litter (manure and bedding) which contains 5 percent nitrogen and he applies this litter to pastures at the rate of 2 tons per acre, how much actual nitrogen per acre would he have placed on his pastures?

200 lbs. of nitrogen (.05 x 400)

9. A soil sample shows your front lawn needs nitrogen at the rate of 50 lbs. per acre to sustain bermudagrass growth through the summer. Assuming your lawn is one-tenth of an acre, how much 10-20-10 fertilizer would it take to provide the recommended amount of nitrogen?

50 lbs. (50/.10 = 500/10)

Assignment Sheet 3—Read a Soil Test Report—Answer Key

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers are correct	_____
• Assignment was completed on time	_____

Directions

Using the soil test report on the following page or one provided by your instructor, answer the questions below.

1. What is the field designation number? 1
2. What is the laboratory number? 79164
3. Soil test results:
 - a. Pounds of nitrogen— 44
 - b. Percent of organic matter— 2.4
 - c. Pounds of phosphorus— 8
 - d. Pounds of potassium— 730
 - e. pH— 7.6
 - f. Texture— Fine
4. Interpretation of test results:
 - a. What is the level of nitrogen? High
 - b. What is the level of phosphorus? Low
 - c. What is the level of potassium? High
 - d. What is the level of organic matter? Low

Assignment Sheet 5—Read a Soil Survey Map—Answer Key

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers are correct	_____
• Assignment was completed on time	_____

Directions

Using the soil survey map on the next page, answer the following questions.

1. List the different soil type map symbols. (**Any order**)
 - a. CeB
 - b. Rs
 - c. CeA
 - d. Bp
2. In what corner of the map is the large residential area? Southeast
3. What soil type is found in the residential area? CeA
4. What soil type is located in areas of streams and possible lowlands?
Rs
5. What soil type is located east of the farmstead? CeA

**Assignment Sheet 6—Read a
Conservation Plan Map—Answer Key**

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers are correct	_____
• Assignment was completed on time	_____

Directions

Using the conservation plan map provided on the next page, answer the following questions.

1. What is the county? Tillman
2. Who was the USDA Natural Resources Conservation Service person who assisted in the development of this plan? Mary Kellum
3. How many acres are in field number 2? 46
4. What is field number 5 used for? Range land
5. What is the land capability class of field number 9? III
6. What is the conservation practice for field number 19? To seed
7. What is the field number 6 used for? Cropland
8. Who owns this land? Darold Hehn
9. How many acres are in field number 17? 25
10. What is the land capability class of field number 4? IV

Assignment Sheet 7—Complete a Land Use Planning Summary—Answer Key

USDA-SCS

LAND USE PLANNING SUMMARY

Cooperator _____ Acres **285** CD _____

Assisted by _____ Date _____

Field	Acres	Land Use					Planned Practices
		Hay Land	Wild Life	Farm Stead	Range Land	Pasture Land	
1	37	37					
2	16	16					To seed 2003
3	2			2			
4	47		47				Brush control 2004
5	138				138		Cross fence 2005
6	45					45	To seed 2003
Total	285	53	47	2	138	45	

Written Test

Name _____

Date _____ Score _____

Objective 1

Match terms related to land management with their definitions. Write the corresponding numbers on the blanks provided. Definitions continue on the next page.

- | | | |
|--------------------------|-------------------|--------------------|
| 1. Contour | 9. Organic matter | 18. Soil structure |
| 2. Depth | 10. Permeability | 19. Soil survey |
| 3. Erosion | 11. Rangeland | 20. Soil texture |
| 4. Land | 12. Reclamation | 21. Surface runoff |
| 5. Land capability class | 13. Slope | 22. Topography |
| 6. Land management | 14. Soil | 23. Weathering |
| 7. Land uses | 15. Soil horizon | 24. Windbreak |
| 8. Land use planning | 16. Soil map | |
| | 17. Soil profile | |

- _____ a. The study of physical features (natural and man-made) on the land's surface
- _____ b. The planning and implementation of practices applied to the land
- _____ c. Any ground, soil or earth whatsoever, regarded as the subject of ownership, and everything annexed to it by nature or by man extending vertically upwards and downwards
- _____ d. The systematic application of human controls to the key elements of an ecosystem in order to derive benefit
- _____ e. The outer portion of the earth's crust that supports plant life
- _____ f. The actions that break down rock into soil
- _____ g. Plant and animal matter in various stages of decay
- _____ h. Side view or vertical cross-section of the soil
- _____ i. A layer of soil materials
- _____ j. The relative proportion of sand, silt, and clay particles in a specific soil mass

Written Test

- _____ k. The total thickness of the surface and subsoil plus any underlying material that is favorable for root development
- _____ l. The number of feet that the land rises or falls in a 100 foot horizontal distance
- _____ m. The wearing away of land surface
- _____ n. The shape and arrangement of soil particles into cluster or aggregates
- _____ o. The movement of air and water through the soil
- _____ p. The relative rate of water is removed by flowing over the soil surface
- _____ q. The suitability of land for a specific agricultural use without permanent damage
- _____ r. An imaginary line along the ground connecting all points on the same elevation
- _____ s. A living barrier of trees and shrubs designed for protection from wind and/or snow
- _____ t. Refers to the land areas of the world that tend to be covered by grasses, grass-like plants, forbs, and shrubs as the primary vegetation instead of trees
- _____ u. Transforming barren areas as nearly as possible to their original condition after surface disturbance
- _____ v. The systematic examination, description, classification, and mapping of soils in an area
- _____ w. A map showing the distribution of soil types
- _____ x. A political process to determine the uses of a given land

Written Test

Objective 2

Distinguish between agricultural and non-agricultural land uses by placing the following letter next to the correct descriptions:

A Agricultural

N Non-Agricultural

- _____ a. Crops
- _____ b. Highways and roads
- _____ c. State and National Parks
- _____ d. National defense areas
- _____ e. Forestry and woodlands
- _____ f. Wildlife areas
- _____ g. Farmsteads and service areas

Objective 3

Match reasons soil is important with their definitions. Write the corresponding numbers on the blanks provided.

1. Aesthetics

2. Habitat for microbes

3. Plant growth

4. Renew water

5. Reservoirs

6. Sites for construction

7. Waste disposal

- _____ a. Soil allows the surface of the earth to be attractive
- _____ b. Structures built in the soil allow natural decay to occur
- _____ c. Soil can be shaped into ponds and lakes to hold water
- _____ d. Soil serves as the part of the earth on which homes and other structures are built
- _____ e. Movement of water through soil to the layers of earth below removes impurities from water
- _____ f. Soil provides a home to many microorganisms
- _____ g. Soil provides nutrients for plant growth and contact with roots anchors plants

Written Test

Objective 4

Complete statements concerning how soils are formed by filling in the blanks with the correct answers. Choose from the following list (not all are needed):

Acids, animals, bacteria, larger, plants, rock, smaller, types, weathering

- a. Soil starts out as _____.
- b. _____ factors work to break rocks down.
- c. Soil _____ are based upon the kind of rock from which it is made.
- d. Small _____ begin to grow within the rock particles.
- e. As more organic matter is formed, _____ plant forms take root.
- f. _____ and fungi break down the organic matter into simpler nutrients that are released into the soil.

Objective 5

Match types of rocks with their definitions. Write the corresponding numbers on the blanks provided.

1. Igneous 2. Sedimentary 3. Metamorphic

- _____ a. Formed by hardening of molten volcanic materials.
- _____ b. Formed as a result of changes in other rocks under heat and pressure
- _____ c. Formed by a consolidation of particles laid down over the years

Objective 6

Match weathering factors with their actions. Write the corresponding numbers on the blanks provided.

1. Temperature changes 4. Chemicals
2. Winds 5. Ice
3. Water 6. Glaciers

- _____ a. Flow ice can move rocks and grind them into pieces
- _____ b. Expansion of frozen water can cause rocks to break
- _____ c. Chemical dissolved in the water eat away rock surface
- _____ d. Water-soluble minerals are dissolved and eroded particles are carried away
- _____ e. Sand may be blown against a larger rock, eroding its surface
- _____ f. Heating and cooling cause rock to crack.

Written Test

Objective 7

Match types of soils with the way they are deposited. Write the corresponding numbers on the blanks provided.

1. Alluvial soils 2. Glacial soils 3. Loess soils

- _____ a. Deposited by glaciers
_____ b. Deposited by moving fresh water
_____ c. Deposited by wind

Objective 8

Select from the following list the composition of an average soil. Circle the correct answer.

- a. Water 50%, air 10%, organic matter 10%, mineral matter 30%
b. Water 25%, air 50%, organic matter 10%, mineral matter 15%
c. Water 25%, air 25%, organic matter 5%, mineral matter 45%
d. Water 25%, air 25%, organic matter 25%, mineral matter 25%

Objective 9

Select from the following list the functions of organic matter by placing an "X" in the blanks next to the true statements.

- _____ a. Provides food for soil microorganisms
_____ b. Makes water in the soil
_____ c. Stores soil moisture
_____ d. Makes soil more tillable
_____ e. Returns plant nutrients to the soil
_____ f. Serves as a cementing agent for soil particles
_____ g. Eliminates air in the soil

Written Test

Objective 10

List three major factors that affect land capability classes.

- a. _____
- b. _____
- c. _____

Objective 11

Match the horizons of a soil profile with their description. Write the corresponding numbers on the blanks provided.

- | | |
|------------------------------|-------------------------------|
| 1. Organic matter; O Horizon | 4. Parent material; C Horizon |
| 2. Topsoil; A Horizon | 5. Bedrock; R Horizon |
| 3. Subsoil; B Horizon | |

- _____ a. Plant and animal matter in various stages of decay
- _____ b. Underlying solid rock
- _____ c. Humus, roots, organisms
- _____ d. Weathered bedrock and some leached materials
- _____ e. Fine particles, leached materials, some roots

Objective 12

Match the terms with their definitions. Write the corresponding numbers on the blanks provided.

- | | |
|-------------------------------|-----------------------------|
| 1. Coarse-textured | 4. Moderately fine-textured |
| 2. Moderately coarse-textured | 5. Fine-textured |
| 3. Medium-textured | |

- _____ a. Soils form very hard, massive lumps or when dry, and are quite plastic and sticky when wet
- _____ b. Soils usually break into clods or lumps when dry
- _____ c. Soils have a slightly smooth or velvety feel when moist
- _____ d. Soils feel gritty but contain enough silt and clay to make moist soil hold together
- _____ e. Soils are loose, very friable, and the individual grains can be readily seen or felt

Written Test

Objective 13

Match the categories of soil depth with their description. Write the corresponding numbers on the blanks provided.

- | | |
|--------------------|-----------------|
| 1. Deep | 3. Shallow |
| 2. Moderately deep | 4. Very shallow |

- _____ a. Less than 10 inches
- _____ b. Over 20 inches but less than 40 inches
- _____ c. Over 10 inches but less than 20 inches
- _____ d. Over 40 inches

Objective 14

Match the terms with their definitions. Write the corresponding numbers on the blanks provided.

- | | |
|-----------------------|---------------------|
| 1. Nearly level | 4. Strongly sloping |
| 2. Gently sloping | 5. Steep |
| 3. Moderately sloping | 6. Very steep |

- _____ a. Over 15 feet elevation change
- _____ b. Less than 1 foot elevation change
- _____ c. 3 to 5 feet elevation change
- _____ d. 1 to 3 feet elevation change
- _____ e. 8 to 15 feet elevation change
- _____ f. 5 to 8 feet elevation change

Objective 15

List two types of erosion.

- a. _____
- b. _____

Written Test

Objective 16

List four causes of erosion.

- a. _____
- b. _____
- c. _____
- d. _____

Objective 17

Complete the following statements concerning the effects of erosion by circling the correct answers.

- a. (Reduces) (Increases) fertility of land
- b. (Reduces) (Increases) sediment in reservoirs and ponds
- c. (Decreases) (Increases) water filtration expenses
- d. (Helps) (Destroys) spawning beds of game fish
- e. (Reduces) (Increases) fish food supply
- f. (Increases) (Decreases) the damage caused by floods

Objective 18

Select from the following list the contributors to erosion pollution by placing an "X" in the blanks next to the true statements.

- _____ a. Riverbank erosion
- _____ b. Farming erodible lands
- _____ c. Unprotected construction sites
- _____ d. Grassed waterway
- _____ e. Industrial and mining activities

Written Test

Objective 19

Match the classes of erosion with their description. Write the corresponding numbers on the blanks provided.

- | | |
|-------------------|----------------|
| 1. None to slight | 3. Severe |
| 2. Moderate | 4. Very severe |

- _____ a. Soils of this class have been eroded to the extent that 75% of the original top soil is removed. Occasional uncrossable gullies may be present.
- _____ b. Soils of this class show no obvious effect of erosion.
- _____ c. Soils of this class have 25% to 50% of the original topsoil present. Occasional crossable gullies may be present.
- _____ d. Soils of this class have over 75% of top soil removed with frequent uncrossable gullies and/or severe accumulations by wind.

Objective 20

Match the types of soil structures with their description. Write the corresponding numbers on the blanks provided. *Note: Not all soil structures are described.*

- | | |
|----------------------|--------------|
| 1. Single grained | 5. Prismatic |
| 2. Granular | 6. Columnar |
| 3. Subangular blocky | 7. Platy |
| 4. Blocky | 8. Massive |

- _____ a. Plate-like or relatively thin horizontal plates or leaflets
- _____ b. Each soil particle functions as an individual unit due to the lack of binding material
- _____ c. Block-like or tending toward a six-faced aggregates have flat surfaces with mostly sharp, angular vertices or edges that are mold casts formed by surrounding aggregates
- _____ d. Block-like or tending toward six-face aggregates having mixed, rounded and flat surfaces with many rounded vertices or corners

Written Test

Objective 21

Match the levels of permeability with their description. Write the corresponding numbers on the blanks provided.

- | | |
|-------------------------|--------------------------|
| 1. Rapidly permeable | 3. Slowly permeable |
| 2. Moderately permeable | 4. Very slowly permeable |

- _____ a. Subsoils are very firm when moist and very firm when dry. Roots are few and generally follow ped faces and cracks.
- _____ b. Subsoils tend to be very friable or loose when moist, and exhibit little restriction of water or air.
- _____ c. Subsoils are firm when moist and firm when dry. Roots are common.
- _____ d. Subsoils are friable to very friable with large pores. Roots are abundant.

Objective 22

Match the classes of surface runoff with their description. Write the corresponding numbers on the blanks provided.

- | | |
|-------------|--------------|
| 1. Rapid | 3. Slow |
| 2. Moderate | 4. Very slow |

- _____ a. Water is removed from the soil at a rapid rate.
- _____ b. Water drains away readily but yet slow enough that a large amount of the water enters the soil.
- _____ c. Water flows away so slowly that free water covers the soil for moderate periods.
- _____ d. Water is removed so slowly or stands so long that the soil remains wet for long periods.

Objective 23

Match the land capability classes with their description. Write the corresponding numbers on the blanks provided. Definitions continue on the next page.

- | | | |
|--------------|-------------|---------------|
| 1. Class I | 4. Class IV | 7. Class VII |
| 2. Class II | 5. Class V | 8. Class VIII |
| 3. Class III | 6. Class VI | |

- _____ a. Land is very productive land that can be cultivated with minimal erosion control measures. It is nearly level, well to moderately-well drained, deep, medium textured, not subject to erosion or flooding, and easily cultivated.

Written Test

- _____ b. Land is nearly level but has some soil property making it unsuitable for cultivation. It has little or no erosion hazard, but may be in a frequent floodplain. It may be very wet (swampy), very dry, or very rocky. This class of land is suitable for pasture, wildlife habitat, or forest production.
- _____ c. Land has one or more extreme limitations. The limitations may be a rock outcropping or an area with almost solid surface rock. River washes, stream beds, lake bottoms, sand dunes, and other nearly barren areas. This class of land can be preserved in its natural state for recreation and wildlife, but has little agricultural value.
- _____ d. Land is suitable for all types of farming, but has some limitations. It may have a gentle slope, may suffer from the effects of past erosion, and may have less than ideal soil depth. It may also have some drainage problems, but these can be corrected by installation of drainage systems. This class of land requires careful soil management to prevent erosion damage.
- _____ e. Land is moderately good land that can be cultivated and farmed regularly, but has some important limitations. It may have a moderate slope, and may be highly susceptible to erosion damage, and may have problems with drainage or have a shallow rooting zone which causes droughtiness. Terracing and other water control measures will be needed. This class of land should be farmed with care to control erosion.
- _____ f. Land has severe limitations, but can be cultivated with careful soil management practices. It may be strongly sloping and may be subject to moderate erosion. It may already suffer from past severe erosion, be very shallow, very dry, or very wet soil. Cultivated areas should be strip tilled, terraced and farmed on the contour. Best suited for pasture and hay meadows.
- _____ g. Land has serious limitations. It may have very rocky or very shallow usable surface soil, may have steep slopes, severe erosion, or already be suffering from severe erosion. This class is suitable for tree production, permanent pasture, wildlife habitat, and recreation.
- _____ h. Land has very severe limitations. It may be severely steep, have very coarse soil, and/or be severely eroded with large gullies. Establishing pasture may be impractical, but native grasses can be used for controlled grazing. This class is suitable for controlled grazing, forest production, wildlife habitat, and recreation.

Written Test

Objective 24

Select true statements concerning soil testing by placing an "X" in the blanks next to the true statements.

- ☐ a. Soils differ in the amount of nutrients they can supply to plants.
- ☐ b. A soil test will determine the exact amount of nutrients a soil can provide.
- ☐ c. Adding major plant nutrients based on a soil test can increase yield and will improve quality of the plant.

Objective 25

Distinguish between major and minor plant nutrients by placing an "X" in the major nutrients.

- ☐ a. Zinc
- ☐ b. Iron
- ☐ c. Potassium
- ☐ d. Sulfur
- ☐ e. Chlorine
- ☐ f. Nitrogen
- ☐ g. Copper
- ☐ h. Phosphorus

Objective 26

Identify the nutrients in the following fertilizer analysis:

a. b. c.

10 - 20 - 10

- a. _____
- b. _____
- c. _____

Written Test

Objective 27

List four methods of controlling erosion on the farm.

- a. _____
- b. _____
- c. _____
- d. _____

Objective 28

Select from the following methods of controlling non-farm erosion by placing an "X" in the blanks next to the correct methods.

- _____ a. Create bare spots between vegetation to allow faster water absorption
- _____ b. Plant trees
- _____ c. Place rock materials along riverbank to secure it.
- _____ d. Leave grass seed exposed on the soil while waiting for it to sprout.
- _____ e. Disturb only the minimum of a construction area.
- _____ f. Base all building plans on scientific soil surveys.

Written Test

Objective 29

Select true statements concerning rangeland management by placing an "X" in the blanks next to the true statements.

- ☐ a. Rangeland makes up about two-thirds of all the land in the United States.
- ☐ b. About 2/3 of the rangeland in the continental United States is privately owned or owned by state and local governments.
- ☐ c. The Bureau of Indian Affairs manages most of the federal land, leasing much of it to ranchers for grazing livestock and buffalo.
- ☐ d. Overgrazing is a condition that occurs in a range area when the grazing capacity is surpassed.
- ☐ e. The primary objective of rangeland management is to produce the maximum amount of grazing for animals useful to humans, while protecting the land from damage due to overuse.

Objective 30

Select true statements concerning reclamation of mined lands by placing an "X" in the blanks next to the true statements.

- ☐ a. Surface strip-mines are required to have a reclamation plan.
- ☐ b. Oxygen is a mineral resource obtained by surface mining.
- ☐ c. Surface mining can be harmful to land.
- ☐ d. Surface mining causes rivers and streams to become choked with sediment.
- ☐ e. As water drains through the mines, X becomes purified.
- ☐ f. To reclaim mined lands, earth-moving equipment is used to fill the mined areas with rock debris, the land is shaped, topsoil is spread, and trees, shrubs, and a mixture of grass are planted.
- ☐ g. Sand and gravel are mined by surface mines.

Written Test

Objective 31

Distinguish between Global Positioning System (GPS) and Geographic Information Systems (GIS) by placing the following letters next to the correct descriptions:

GPS—Global Positioning System

GIS—Geographic Information Systems

- _____ a. Network of satellites that are designed to help ground based units determine their current location in latitude and longitude coordinates.
- _____ b. A true system includes data, computer, hardware, software, and users.
- _____ c. Designed for the collection, storage, and analysis of objects and phenomena where geographic location is an important characteristic or critical in the analysis.
- _____ d. This system was implemented and is managed by the U.S. Department of Defense.
- _____ e. Map overlay is probably the most common function.

Objective 32

Select true statements concerning soil survey reports by placing an "X" in the blanks next to the true statements.

- _____ a. Soil survey reports contain aerial photograph maps for an entire state.
- _____ b. Soil survey reports give descriptions of soils in a county.
- _____ c. Soil survey reports list management information to assist in land use planning.

Objective 33

List four parts of a conservation plan.

- a. _____
- b. _____
- c. _____
- d. _____

Written Test

Objective 34

List the four parts of a land use planning summary.

- a. _____
- b. _____
- c. _____
- d. _____

Objective 35

List three stewards of the soil.

- a. _____
- b. _____
- c. _____

Objective 36

Distinguish between the United States Department of Agriculture (USDA) and United States Department of Interior (DOI) roles in land management by placing the following letters next to the correct descriptions:

USDA—U.S. Department of Agriculture

DOI—U.S. Department of Interior

- _____ a. Provides a portfolio of voluntary assistance, including cost-share, land rental, incentive payments, and technical assistance.
- _____ b. Implements legislation and provides resources toward conservation on private lands.
- _____ c. Is the steward and guardian of our nation's natural resources and cultural heritage.
- _____ d. Is the nation's principal conservation agency for public lands owned by the federal government.
- _____ e. Responds to a broad range of emerging natural resource challenges faced by farmers and ranchers, including soil erosion, wetlands, wildlife habitat, and farmland protection.
- _____ f. Manages 1/5 of the surface land in the United States.

Written Test

Objective 37

List two career opportunities in land management.

- a. _____
- b. _____

*Permission to duplicate this test is granted.

Written Test—Answer Key

Objective 1

Match terms related to land management with their definitions. Write the corresponding numbers on the blanks provided. Definitions continue on the next page.

- | | | |
|--------------------------|-------------------|--------------------|
| 1. Contour | 9. Organic matter | 18. Soil structure |
| 2. Depth | 10. Permeability | 19. Soil survey |
| 3. Erosion | 11. Rangeland | 20. Soil texture |
| 4. Land | 12. Reclamation | 21. Surface runoff |
| 5. Land capability class | 13. Slope | 22. Topography |
| 6. Land management | 14. Soil | 23. Weathering |
| 7. Land uses | 15. Soil horizon | 24. Windbreak |
| 8. Land use planning | 16. Soil map | |
| | 17. Soil profile | |

- 22 a. The study of physical features (natural and man-made) on the land's surface
- 6 b. The planning and implementation of practices applied to the land
- 4 c. Any ground, soil or earth whatsoever, regarded as the subject of ownership, and everything annexed to it by nature or by man extending vertically upwards and downwards
- 7 d. The systematic application of human controls to the key elements of an ecosystem in order to derive benefit
- 14 e. The outer portion of the earth's crust that supports plant life
- 23 f. The actions that break down rock into soil
- 9 g. Plant and animal matter in various stages of decay
- 17 h. Side view or vertical cross-section of the soil
- 15 i. A layer of soil materials
- 20 j. The relative proportion of sand, silt, and clay particles in a specific soil mass

Written Test—Answer Key

- | | | |
|-----------|----|---|
| <u>2</u> | k. | The total thickness of the surface and subsoil plus any underlying material that is favorable for root development |
| <u>13</u> | l. | The number of feet that the land rises or falls in a 100 foot horizontal distance |
| <u>3</u> | m. | The wearing away of land surface |
| <u>18</u> | n. | The shape and arrangement of soil particles into cluster or aggregates |
| <u>10</u> | o. | The movement of air and water through the soil |
| <u>21</u> | p. | The relative rate of water is removed by flowing over the soil surface |
| <u>5</u> | q. | The suitability of land for a specific agricultural use without permanent damage |
| <u>1</u> | r. | An imaginary line along the ground connecting all points on the same elevation |
| <u>24</u> | s. | A living barrier of trees and shrubs designed for protection from wind and/or snow |
| <u>11</u> | t. | Refers to the land areas of the world that tend to be covered by grasses, grass-like plants, forbs, and shrubs as the primary vegetation instead of trees |
| <u>12</u> | u. | Transforming barren areas as nearly as possible to their original condition after surface disturbance |
| <u>19</u> | v. | The systematic examination, description, classification, and mapping of soils in an area |
| <u>16</u> | w. | A map showing the distribution of soil types |
| <u>8</u> | x. | A political process to determine the uses of a given land |

Written Test—Answer Key

Objective 2

Distinguish between agricultural and non-agricultural land uses by placing the following letter next to the correct descriptions:

A Agricultural

N Non-Agricultural

- A a. Crops
- N b. Highways and roads
- N c. State and National Parks
- N d. National defense areas
- A e. Forestry and woodlands
- N f. Wildlife areas
- A g. Farmsteads and service areas

Objective 3

Match reasons soil is important with their definitions. Write the corresponding numbers on the blanks provided.

1. Aesthetics

2. Habitat for microbes

3. Plant growth

4. Renew water

5. Reservoirs

6. Sites for construction

7. Waste disposal

- 1 a. Soil allows the surface of the earth to be attractive
- 7 b. Structures built in the soil allow natural decay to occur
- 5 c. Soil can be shaped into ponds and lakes to hold water
- 6 d. Soil serves as the part of the earth on which homes and other structures are built
- 4 e. Movement of water through soil to the layers of earth below removes impurities from water
- 2 f. Soil provides a home to many microorganisms
- 3 g. Soil provides nutrients for plant growth and contact with roots anchors plants

Written Test—Answer Key

Objective 4

Complete statements concerning how soils are formed by filling in the blanks with the correct answers. Choose from the following list (not all are needed):

Acids, animals, bacteria, larger, plants, rock, smaller, types, weathering

- a. Soil starts out as **rock**.
- b. **Weathering** factors work to break rocks down.
- c. Soil **types** are based upon the kind of rock from which it is made.
- d. Small **plants** begin to grow within the rock particles.
- e. As more organic matter is formed, **larger** plant forms take root.
- f. **Bacteria** and fungi break down the organic matter into simpler nutrients that are released into the soil.

Objective 5

Match types of rocks with their definitions. Write the corresponding numbers on the blanks provided.

- | | | |
|------------|----------------|----------------|
| 1. Igneous | 2. Sedimentary | 3. Metamorphic |
|------------|----------------|----------------|

- 1 a. Formed by hardening of molten volcanic materials.
- 3 b. Formed as a result of changes in other rocks under heat and pressure
- 2 c. Formed by a consolidation of particles laid down over the years

Objective 6

Match weathering factors with their actions. Write the corresponding numbers on the blanks provided.

- | | |
|------------------------|--------------|
| 1. Temperature changes | 4. Chemicals |
| 2. Winds | 5. Ice |
| 3. Water | 6. Glaciers |

- 6 a. Flow ice can move rocks and grind them into pieces
- 5 b. Expansion of frozen water can cause rocks to break
- 4 c. Chemical dissolved in the water eat away rock surface
- 3 d. Water-soluble minerals are dissolved and eroded particles are carried away
- 2 e. Sand may be blown against a larger rock, eroding its surface
- 1 f. Heating and cooling cause rock to crack.

Written Test—Answer Key

Objective 7

Match types of soils with the way they are deposited. Write the corresponding numbers on the blanks provided.

1. Alluvial soils 2. Glacial soils 3. Loess soils

- 2 a. Deposited by glaciers
1 b. Deposited by moving fresh water
3 c. Deposited by wind

Objective 8

Select from the following list the composition of an average soil. Circle the correct answer.

- a. Water 50%, air 10%, organic matter 10%, mineral matter 30%
b. Water 25%, air 50%, organic matter 10%, mineral matter 15%
c. Water 25%, air 25%, organic matter 5%, mineral matter 45%
d. Water 25%, air 25%, organic matter 25%, mineral matter 25%

Objective 9

Select from the following list the functions of organic matter by placing an "X" in the blanks next to the true statements.

- X a. Provides food for soil microorganisms
 b. Makes water in the soil
X c. Stores soil moisture
X d. Makes soil more tillable
X e. Returns plant nutrients to the soil
X f. Serves as a cementing agent for soil particles
 g. Eliminates air in the soil

Written Test—Answer Key

Objective 10

List three major factors that affect land capability classes.

Any three of the following:

- Texture
- Depth
- Slope
- Erosion
- Permeability or surface runoff

Objective 11

Match the horizons of a soil profile with their description. Write the corresponding numbers on the blanks provided.

- | | |
|------------------------------|-------------------------------|
| 1. Organic matter; O Horizon | 4. Parent material; C Horizon |
| 2. Topsoil; A Horizon | 5. Bedrock; R Horizon |
| 3. Subsoil; B Horizon | |

- 1 a. Plant and animal matter in various stages of decay
- 5 b. Underlying solid rock
- 2 c. Humus, roots, organisms
- 4 d. Weathered bedrock and some leached materials
- 3 e. Fine particles, leached materials, some roots

Objective 12

Match the terms with their definitions. Write the corresponding numbers on the blanks provided.

- | | |
|-------------------------------|-----------------------------|
| 1. Coarse-textured | 4. Moderately fine-textured |
| 2. Moderately coarse-textured | 5. Fine-textured |
| 3. Medium-textured | |

- 5 a. Soils form very hard, massive lumps or when dry, and are quite plastic and sticky when wet
- 4 b. Soils usually break into clods or lumps when dry
- 3 c. Soils have a slightly smooth or velvety feel when moist
- 2 d. Soils feel gritty but contain enough silt and clay to make moist soil hold together
- 1 e. Soils are loose, very friable, and the individual grains can be readily seen or felt

Written Test—Answer Key

Objective 13

Match the categories of soil depth with their description. Write the corresponding numbers on the blanks provided.

- | | |
|--------------------|-----------------|
| 1. Deep | 3. Shallow |
| 2. Moderately deep | 4. Very shallow |

- 4 a. Less than 10 inches
2 b. Over 20 inches but less than 40 inches
3 c. Over 10 inches but less than 20 inches
1 d. Over 40 inches

Objective 14

Match the terms with their definitions. Write the corresponding numbers on the blanks provided.

- | | |
|-----------------------|---------------------|
| 1. Nearly level | 4. Strongly sloping |
| 2. Gently sloping | 5. Steep |
| 3. Moderately sloping | 6. Very steep |

- 6 a. Over 15 feet elevation change
1 b. Less than 1 foot elevation change
3 c. 3 to 5 feet elevation change
2 d. 1 to 3 feet elevation change
5 e. 8 to 15 feet elevation change
4 f. 5 to 8 feet elevation change

Objective 15

List two types of erosion.

Any order:

- Wind
- Water

Written Test—Answer Key

Objective 16

List four causes of erosion.

Any four of the following:

- Moving water
- Topography including slopes of the land
- Lack of vegetation
- Dry climate conditions
- Wind
- Human activities

Objective 17

Complete the following statements concerning the effects of erosion by circling the correct answers.

- a. (**Reduces**) (Increases) fertility of land
- b. (Reduces) (**Increases**) sediment in reservoirs and ponds
- c. (Decreases) (**Increases**) water filtration expenses
- d. (Helps) (**Destroys**) spawning beds of game fish
- e. (**Reduces**) (Increases) fish food supply
- f. (**Increases**) (Decreases) the damage caused by floods

Objective 18

Select from the following list the contributors to erosion pollution by placing an "X" in the blanks next to the true statements.

- X a. Riverbank erosion
- X b. Farming erodible lands
- X c. Unprotected construction sites
- d. Grassed waterway
- X e. Industrial and mining activities

Written Test—Answer Key

Objective 19

Match the classes of erosion with their description. Write the corresponding numbers on the blanks provided.

- | | |
|-------------------|----------------|
| 1. None to slight | 3. Severe |
| 2. Moderate | 4. Very severe |

- 3 a. Soils of this class have been eroded to the extent that 75% of the original top soil is removed. Occasional uncrossable gullies may be present.
- 1 b. Soils of this class show no obvious effect of erosion.
- 2 c. Soils of this class have 25% to 50% of the original topsoil present. Occasional crossable gullies may be present.
- 4 d. Soils of this class have over 75% of top soil removed with frequent uncrossable gullies and/or severe accumulations by wind.

Objective 20

Match the types of soil structures with their description. Write the corresponding numbers on the blanks provided. *Note: Not all soil structures are described.*

- | | |
|----------------------|--------------|
| 1. Single grained | 5. Prismatic |
| 2. Granular | 6. Columnar |
| 3. Subangular blocky | 7. Platy |
| 4. Blocky | 8. Massive |

- 7 a. Plate-like or relatively thin horizontal plates or leaflets
- 1 b. Each soil particle functions as an individual unit due to the lack of binding material
- 4 c. Block-like or tending toward a six-faced aggregates have flat surfaces with mostly sharp, angular vertices or edges that are mold casts formed by surrounding aggregates
- 3 d. Block-like or tending toward six-face aggregates having mixed, rounded and flat surfaces with many rounded vertices or comers

Written Test—Answer Key

Objective 21

Match the levels of permeability with their description. Write the corresponding numbers on the blanks provided.

- | | |
|-------------------------|--------------------------|
| 1. Rapidly permeable | 3. Slowly permeable |
| 2. Moderately permeable | 4. Very slowly permeable |

4 a. Subsoils are very firm when moist and very firm when dry. Roots are few and generally follow ped faces and cracks.

1 b. Subsoils tend to be very friable or loose when moist, and exhibit little restriction of water or air.

3 c. Subsoils are firm when moist and firm when dry. Roots are common.

2 d. Subsoils are friable to very friable with large pores. Roots are abundant.

Objective 22

Match the classes of surface runoff with their description. Write the corresponding numbers on the blanks provided.

- | | |
|-------------|--------------|
| 1. Rapid | 3. Slow |
| 2. Moderate | 4. Very slow |

1 a. Water is removed from the soil at a rapid rate.

2 b. Water drains away readily but yet slow enough that a large amount of the water enters the soil.

3 c. Water flows away so slowly that free water covers the soil for moderate periods.

4 d. Water is removed so slowly or stands so long that the soil remains wet for long periods.

Objective 23

Match the land capability classes with their description. Write the corresponding numbers on the blanks provided. Definitions continue on the next page.

- | | | |
|--------------|-------------|---------------|
| 1. Class I | 4. Class IV | 7. Class VII |
| 2. Class II | 5. Class V | 8. Class VIII |
| 3. Class III | 6. Class VI | |

1 a. Land is very productive land that can be cultivated with minimal erosion control measures. It is nearly level, well to moderately well drained, deep, medium textured, not subject to erosion or flooding, and easily cultivated.

Written Test—Answer Key

- | | | |
|----------|----|---|
| <u>5</u> | b. | Land is nearly level but has some soil property making it unsuitable for cultivation. It has little or no erosion hazard, but may be in a frequent floodplain. It may be very wet (swampy), very dry, or very rocky. This class of land is suitable for pasture, wildlife habitat, or forest production. |
| <u>8</u> | c. | Land has one or more extreme limitations. The limitations may be a rock outcropping or an area with almost solid surface rock. River washes, stream beds, lake bottoms, sand dunes, and other nearly barren areas. This class of land can be preserved in its natural state for recreation and wildlife, but has little agricultural value. |
| <u>2</u> | d. | Land is suitable for all types of farming, but has some limitations. It may have a gentle slope, may suffer from the effects of past erosion, and may have less than ideal soil depth. It may also have some drainage problems, but these can be corrected by installation of drainage systems. This class of land requires careful soil management to prevent erosion damage. |
| <u>3</u> | e. | Land is moderately good land that can be cultivated and farmed regularly, but has some important limitations. It may have a moderate slope, and may be highly susceptible to erosion damage, and may have problems with drainage or have a shallow rooting zone which causes droughtiness. Terracing and other water control measures will be needed. This class of land should be farmed with care to control erosion. |
| <u>4</u> | f. | Land has severe limitations, but can be cultivated with careful soil management practices. It may be strongly sloping and may be subject to moderate erosion. It may already suffer from past severe erosion, be very shallow, very dry, or very wet soil. Cultivated areas should be strip tilled, terraced and farmed on the contour. Best suited for pasture and hay meadows. |
| <u>6</u> | g. | Land has serious limitations. It may have very rocky or very shallow usable surface soil, may have steep slopes, severe erosion, or already be suffering from severe erosion. This class is suitable for tree production, permanent pasture, wildlife habitat, and recreation. |
| <u>7</u> | h. | Land has very severe limitations. It may be severely steep, have very coarse soil, and/or be severely eroded with large gullies. Establishing pasture may be impractical, but native grasses can be used for controlled grazing. This class is suitable for controlled grazing, forest production, wildlife habitat, and recreation. |

Written Test—Answer Key

Objective 24

Select true statements concerning soil testing by placing an "X" in the blanks next to the true statements.

- ☒ a. Soils differ in the amount of nutrients they can supply to plants.
- ☒ b. A soil test will determine the exact amount of nutrients a soil can provide.
- ☒ c. Adding major plant nutrients based on a soil test can increase yield and will improve quality of the plant.

Objective 25

Distinguish between major and minor plant nutrients by placing an "X" in the major nutrients.

- ☐ a. Zinc
- ☐ b. Iron
- ☒ c. Potassium
- ☐ d. Sulfur
- ☐ e. Chlorine
- ☒ f. Nitrogen
- ☐ g. Copper
- ☒ h. Phosphorus

Objective 26

Identify the nutrients in the following fertilizer analysis:

a. b. c.
10 - 20 - 10

- a. Nitrogen (N)
- b. Phosphorus (P)
- c. Potassium (K)

Written Test—Answer Key

Objective 27

List four methods of controlling erosion on the farm.

Any four of the following:

- Plant buffer strips of perennial grasses to hold soil particles
- Plant windbreaks to slow wind speeds
- Ridge soil into small furrows to trap soil particles
- Provide diversions to channel excess runoff
- Farm on the contour rather than straight-row up and down hills
- Terrace to control and manage water runoff
- Use contour strip cropping
- Use rotation cropping
- Practice conservation tillage
- Use tile drainage to remove excess underground water
- Use grassed waterways to channel excess runoff
- Mulch to hold soil in place
- Prevent overgrazing of pastures and rangelands
- Use field borders to perennial vegetation to protect field edges

Objective 28

Select from the following methods of controlling non-farm erosion by placing an "X" in the blanks next to the correct methods.

- ☐ a. Create bare spots between vegetation to allow faster water absorption
- ☒ b. Plant trees
- ☒ c. Place rock materials along riverbank to secure it.
- ☐ d. Leave grass seed exposed on the soil while waiting for it to sprout.
- ☒ e. Disturb only the minimum of a construction area.
- ☒ f. Base all building plans on scientific soil surveys.

Written Test—Answer Key

Objective 29

Select true statements concerning rangeland management by placing an "X" in the blanks next to the true statements.

- ☐ a. Rangeland makes up about two-thirds of all the land in the United States.
- ☒ b. About 2/3 of the rangeland in the continental United States is privately owned or owned by state and local governments.
- ☐ c. The Bureau of Indian Affairs manages most of the federal land, leasing much of it to ranchers for grazing livestock and buffalo.
- ☒ d. Overgrazing is a condition that occurs in a range area when the grazing capacity is surpassed.
- ☒ e. The primary objective of rangeland management is to produce the maximum amount of grazing for animals useful to humans, while protecting the land from damage due to overuse.

Objective 30

Select true statements concerning reclamation of mined lands by placing an "X" in the blanks next to the true statements.

- ☒ a. Surface strip-mines are required to have a reclamation plan.
- ☐ b. Oxygen is a mineral resource obtained by surface mining.
- ☒ c. Surface mining can be harmful to land.
- ☒ d. Surface mining causes rivers and streams to become choked with sediment.
- ☐ e. As water drains through the mines, X becomes purified.
- ☒ f. To reclaim mined lands, earth-moving equipment is used to fill the mined areas with rock debris, the land is shaped, topsoil is spread, and trees, shrubs, and a mixture of grass are planted.
- ☒ g. Sand and gravel are mined by surface mines.

Written Test—Answer Key

Objective 31	Distinguish between Global Positioning System (GPS) and Geographic Information Systems (GIS) by placing the following letters next to the correct descriptions: GPS—Global Positioning System GIS—Geographic Information Systems <u>GPS</u> a. Network of satellites that are designed to help ground based units determine their current location in latitude and longitude coordinates. <u>GIS</u> b. A true system includes data, computer, hardware, software, and users. <u>GIS</u> c. Designed for the collection, storage, and analysis of objects and phenomena where geographic location is an important characteristic or critical in the analysis. <u>GPS</u> d. This system was implemented and is managed by the U.S. Department of Defense. <u>GIS</u> e. Map overlay is probably the most common function.
Objective 32	Select true statements concerning soil survey reports by placing an "X" in the blanks next to the true statements. <u>X</u> a. Soil survey reports contain aerial photograph maps for an entire state. <u>X</u> b. Soil survey reports give descriptions of soils in a county. <u>X</u> c. Soil survey reports list management information to assist in land use planning.
Objective 33	List four parts of a conservation plan. Any four of the following: • Soil map • Land use • Soil type and symbols • Acres • Capability class • Slope • Planned conservation treatment

Written Test—Answer Key

Objective 34	List the four parts of a land use planning summary. In any order: • Field number or name • Acres • Land use • Planned practices
Objective 35	List three stewards of the soil. Any three of the following: • Private land owners • Research and education groups such as land-grant colleges, high school agricultural programs, youth organizations • Government agencies such as USDA, DOI, U.S. Corps of Engineers
Objective 36	Distinguish between the United States Department of Agriculture (USDA) and United States Department of Interior (DOI) roles in land management by placing the following letters next to the correct descriptions: USDA—U.S. Department of Agriculture DOI—U.S. Department of Interior <u>USDA</u> a. Provides a portfolio of voluntary assistance, including cost-share, land rental, incentive payments, and technical assistance. <u>USDA</u> b. Implements legislation and provides resources toward conservation on private lands. <u>DOI</u> c. Is the steward and guardian of our nation's natural resources and cultural heritage. <u>DOI</u> d. Is the nation's principal conservation agency for public lands owned by the federal government. <u>USDA</u> e. Responds to a broad range of emerging natural resource challenges faced by farmers and ranchers, including soil erosion, wetlands, wildlife habitat, and farmland protection. <u>DOI</u> f. Manages 1/5 of the surface land in the United States.

Written Test—Answer Key

Objective 37

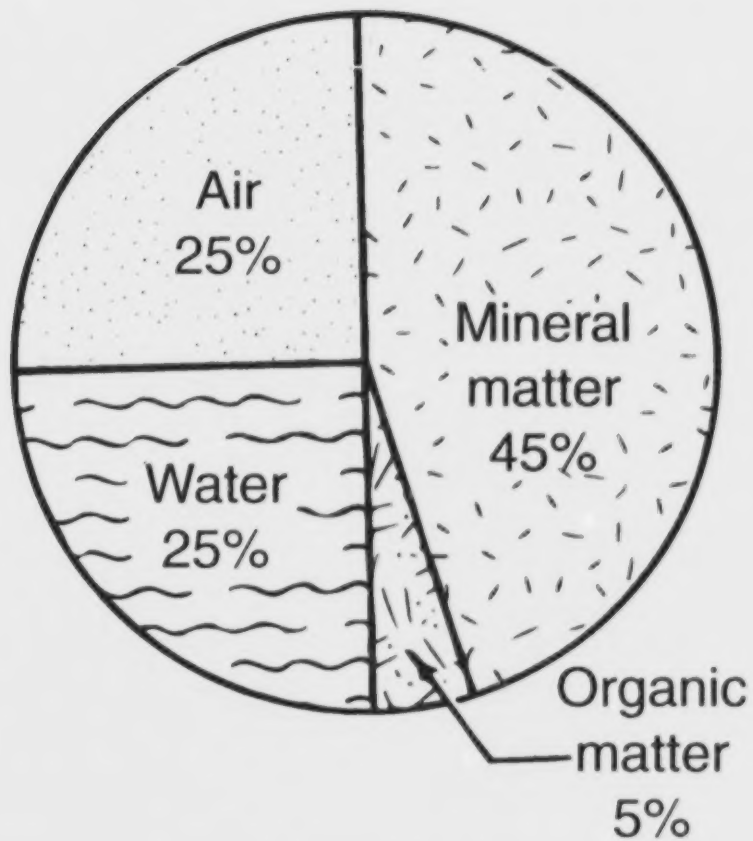
List two career opportunities in land management.

Any two of the following:

- Soil conservationist
- Soil conservation technician
- Soil scientist
- Soil engineer
- Range specialist
- Wildlife conservationist
- Ranch manager
- Farmer

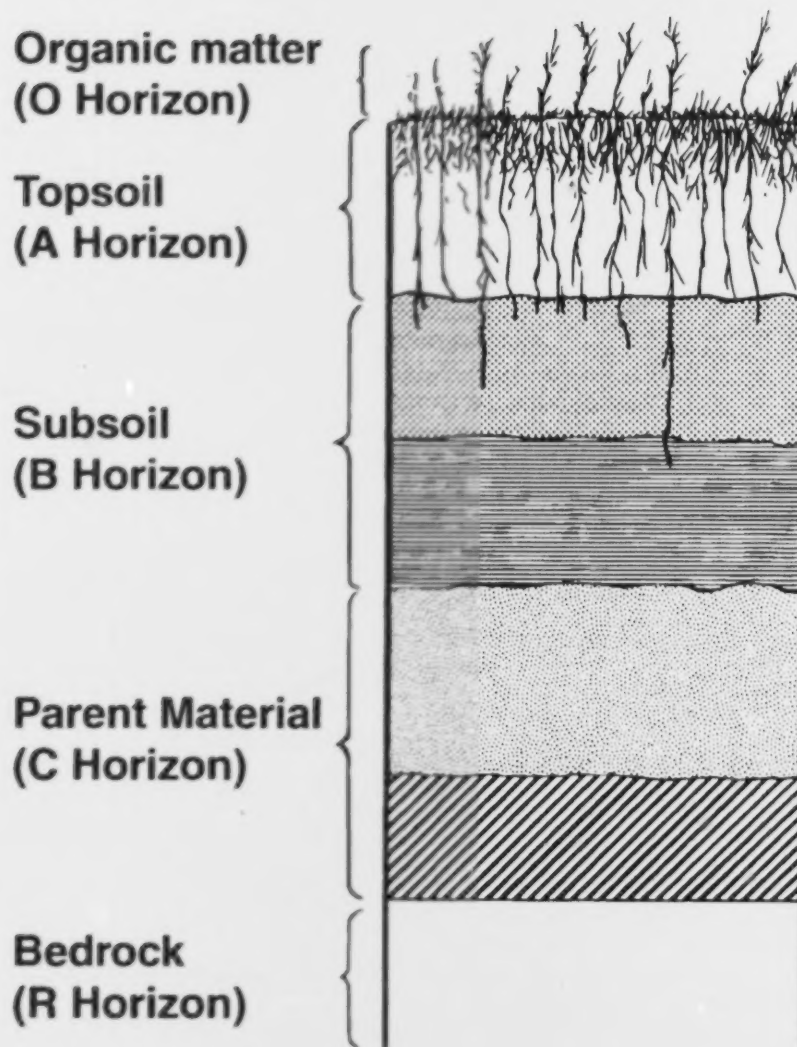
*Permission to duplicate this test is granted.

Composition of Average Soil



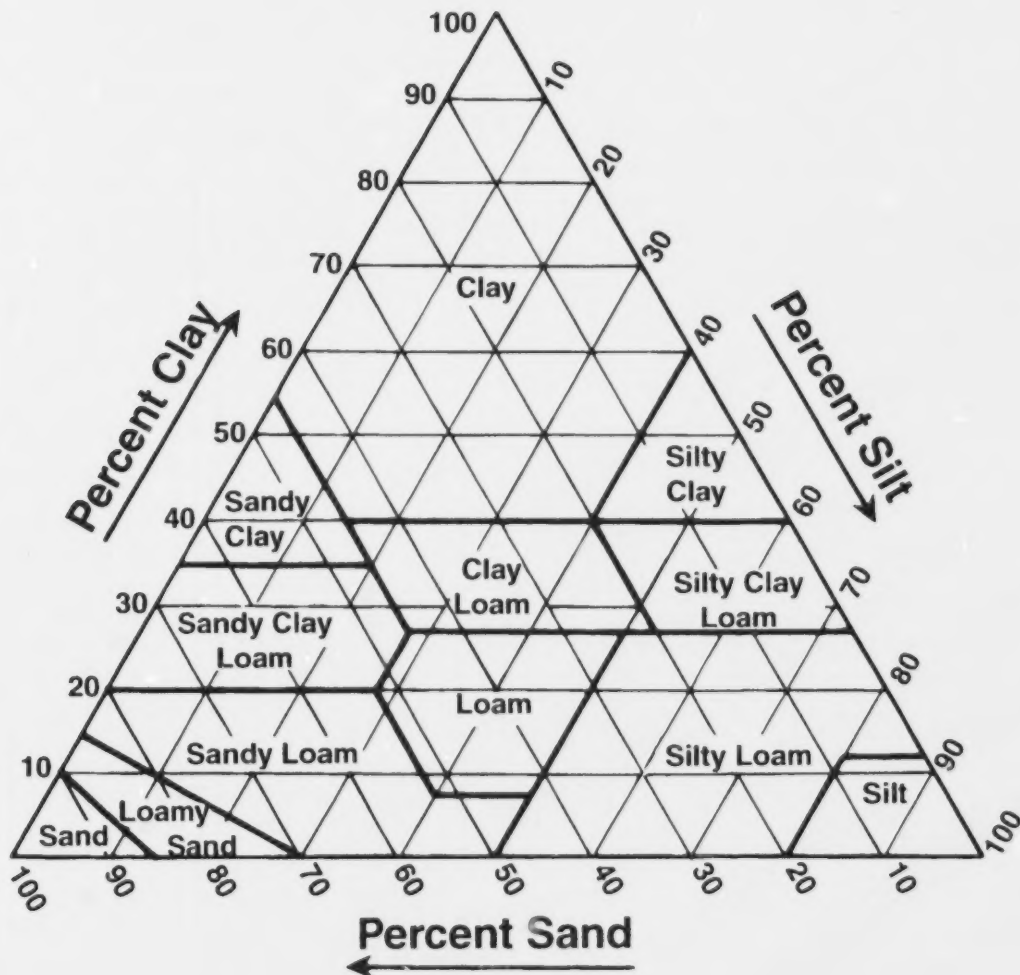
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Soil Profile



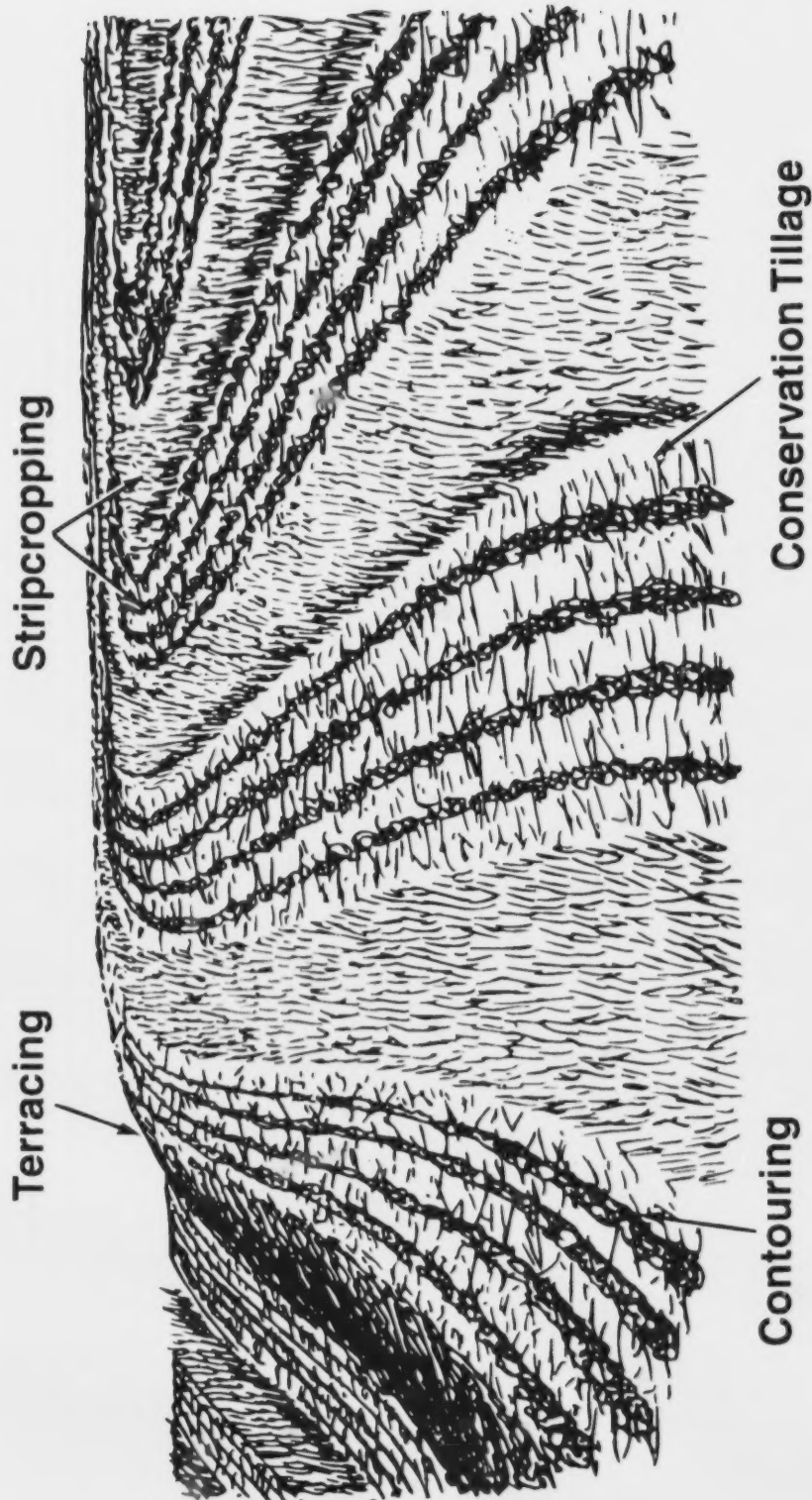
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Soil Textures and Their Particles

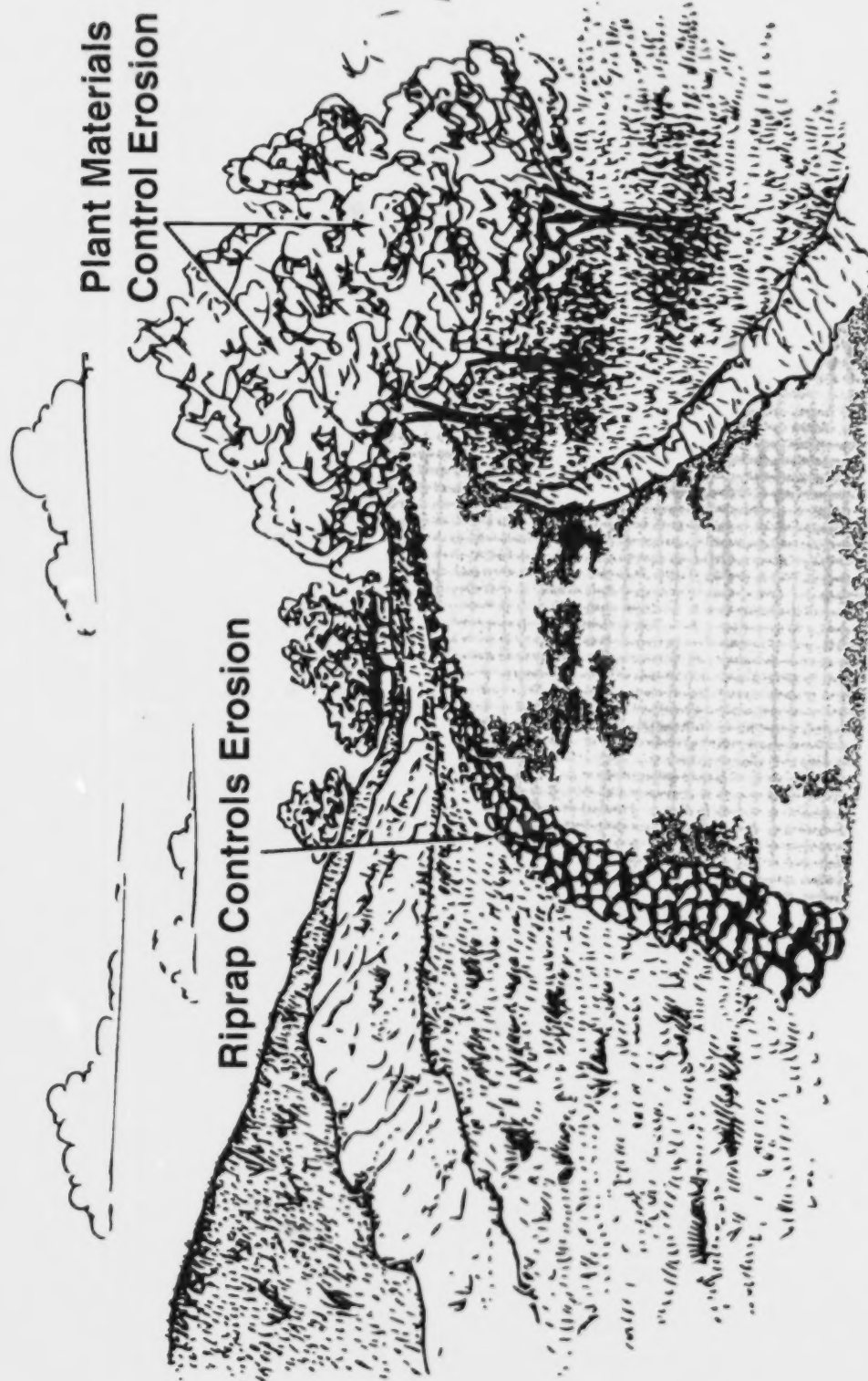


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Controlling Erosion on Farmlands



Controlling Erosion Along Riverbanks



Unit 5**Air Resource Management**

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* Assignment Sheets are located in the Student Workbook.

Instructional
Plan

Suggested Activities

Preparation

- Review the objective sheet. Study the specific objectives to determine the order in which you will present the objectives.
- Review the suggested lesson plan. The plan identifies an order for instruction to take place. Each "day" represents a 50-minute class period. The plan is designed to cover the specific objectives over a 15-day period. Additional days and/or activities may be added. (Note: You may want to change days to specific dates. Example: Day 1 may become Monday, December 11, Day 2 = Tuesday, December 12, and so forth.) You will want to localize, supplement, and personalize the plan to fit your situation.
- Review teaching suggestions included this instructional plan section to plan classroom activities. Also note the suggestions for supplemental resources.
- Plan your delivery/application to take advantage of student learning styles and to accommodate special-needs students.
- Obtain films, videotapes, and other media to supplement instruction of this unit. See "Resources Used in Developing This Unit" and "Suggested Supplemental Resources" for more information.
- Make transparencies or computer presentation from the transparency masters included in this unit. These appear in the teacher edition only and should be used with objectives as indicated below.

TM 1 – The Nitrogen Cycle (Objective 2)

TM 2 – Air Pollutants (Objective 4)

TM 3 – Greenhouse Effect (Objective 5)

TM 4 – Acid Rain (Objective 5)

TM 5 – Ozone Shield (Objective 5)

TM 6 – Smog (Objective 5)

TM 7 – Indoor Air Pollution (Objective 6)

- Use the following teacher supplements to enhance your delivery and application.

TS 1 – The Nitrogen Cycle (Objective 2)

TS 2 – Understanding the Greenhouse Effect (Objective 5)

TS 3 – Mixing Acids and Bases (Objective 5)

TS 4 – Air Pollution in the Past: An Overview (Objective 8)

TS 5 – Air Pollution Allowance Trading Game (Objective 10)

Suggested Activities

- Use the following student supplements to enhance the information and assignment sheets.

SS 1 – Allowance Trading System (Objective 10)

SS 2 – Understanding the Weather (Objective 14 and Assignment Sheet 3)

SS 3 – Forecasting the Weather (Assignment Sheet 4)

- Select teacher components (teacher supplements, unit review, written test) you want to distribute to your students. Copy and prepare these components for distribution.
- Prepare classroom. Put up posters and charts and display articles and other references related to the objectives of this unit.

Delivery and Application

- Discuss unit and specific objectives.
- Discuss information sheets. Implement teaching plan to localize, supplement, and personalize the unit. Reinforce basic academic and workplace skills when applicable.
- Discuss the assignment sheets. Review with students the criteria for evaluation of each of these activities.

Teaching Suggestions

The skill areas appearing in bold-face type in the teaching suggestions refer to the academic and workplace skills identified in *What Work Requires of Schools: A SCANS Report for America 2000* and *Workplace Basics: The Skills Employers Want*. These have been adapted by MAVCC.

- From a salvage yard or muffler shop, obtain a used catalytic converter plugged by improper use of leaded fuel, cut it open, and demonstrate it to the class. If possible, compare the plugged unit with a cross section of a new catalytic converter. (**Listening; oral communication; critical thinking**)
- Invite a mechanic to discuss with the class the effects of a plugged catalytic converter and why proper maintenance of modern emission equipment makes automobile operation more economical. (**Listening; oral communication; critical thinking**)
- Have a state health department employee bring to class and demonstrate air sampling equipment. This equipment is usually set up and left in place for several days; therefore, the students can use the equipment to test for pollen, mold, and particulates. (**Listening; applying a scientific technique; critical thinking**)

Suggested Activities

- Invite industry and government officials to discuss with the class careers in air resource management. (**Listening; oral communication; career awareness**)
- Arrange for a test of the school facilities or student homes for the presence of radon gas. Contact state health department officials for more information.
- Arrange for the class to obtain access to an on-line computer service. Help them collect information for their reports on an environmental problem (Assignment Sheet 2). Also arrange for the class to use a computer service to observe the weather reports and colorful weather maps available. (**Utilizing technology; acquiring scientific data**)
- Obtain an aneroid barometer and wind vane. Use student supplements and assignment sheets to discuss weather and weather forecasting. Assign each student a day to make visual weather observations, determine wind direction, and take barometric readings. Once these readings have been taken, the student should then give the class an oral weather report based on his or her personal findings and related forecast material from radio, television, and computer services. (**Acquiring scientific information; applying scientific techniques; utilizing technology; critical thinking; oral communication; problem solving; listening**)

Evaluation

- Give and evaluate Air Resource Management Review.
- Copy written test and give to students as pretest.
- Evaluate assignment sheets. See the evaluation criteria listed at the top of each assignment sheet. Evaluation may be localized, personalized, or individualized to fit your situation. Record student's grade in your grade book.
- Give and evaluate written test. Record student's written test score in your grade book and on the student's competency profile.
- Measure competency gains by comparing written pretest scores with posttest scores.
- Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas of improvement.
- Reteach and retest as required.

Suggested Activities

Instructions for Evaluating Student Performance

- When the student is ready to perform a specific task, obtain a copy of the assignment sheet which may be found in the student workbook.
- Once the student has completed an assignment sheet, evaluate the student's work using the evaluation criteria. If the student's work is unsatisfactory, have the student review the assignment sheet and submit their work for evaluation again. Record the appropriate level of competency on the student's competency profile.
- Sample performance evaluation keys have been provided below. Many other keys are available. Select one rating (grading scale) which best fits your program needs.

Sample A

- 4—**Skilled**—Can perform job with no additional training.
- 3—**Moderately skilled**—Has performed job during training program; limited additional training may be required.
- 2—**Limited skill**—Has performed job during training program; additional training is required to develop skill.
- 1—**Unskilled**—Is familiar with process, but is unable to perform job.
- 0—**No exposure**—No information or practice provided during training program.

Sample B

- Yes**—Can perform job with no additional training.
- No**—Is unable to perform job satisfactorily.

- Encourage students to continue their portfolio. The portfolio should become a record of the student's progress in the study of natural resources.

Resources Used in Developing This Unit

Note: URLs change frequently. Any of the websites may have moved.

- Birkenholz, Robert J. and Bryan L. Garton, *Applied Environmental Science*, University of Missouri, National Council for Agricultural Education, 1996.
- Lee, Jasper S., *Natural Resources and Environmental Technology*, Danville, IL, Interstate Publishers, Inc., 2000.
www.interstatepublishers.com
- Porter, Lynn, Jasper S. Lee, Diana L. Turner, and Malcolm Hillan, *Environmental Science and Technology (2nd Edition)*, Danville, IL, Interstate Publishers, Inc., 2003.
www.interstatepublishers.com
- U.S. Environmental Protection Agency, *Plain English Guide to the Clean Air Act*, Washington, D.C.
www.epa.gov/air

Suggested Activities

Suggested Supplemental Resources

- U.S. Environmental Protection Agency, *What Can You Do to Clean the Air*, Washington, D.C.
www.epa.gov/air
- U.S. Environmental Protection Agency, *Air Pollution, What's the Solution*, Washington, D.C.
www.epa.gov/air

Print Media

- American Petroleum Institute
Public Affairs Dept.
1220 L Street, N.W.
Washington, D.C. 20005
Web site www.api.org has information about oil and natural gas industry. Check out Energy Consumer Site for *In the Classroom, Environmental Issues, and Clean Air*.
- Global Climate Coalition
1275 K St., N.W.
Washington, D.C. 20005
Voice of business and industry on global warming issues.
Web site: www.globalclimate.org
- American Coal Foundation
1130 Seventeenth St., N.W.
Suite 220
Washington, D.C. 20036
The mission of ACF is to develop materials and programs to assist educating teachers and students about today's modern coal industry, so that future generations will be able to make well-informed decisions about the economy, the environment, and our country's national security. Foundation has videos, printed products, news and events, FAQ and coal quiz. Web site: www.acf-coal.org
- Films for the Humanities and Sciences
P.O. Box 2053
Princeton, NJ 08543
(800) 257-5126
More than 7,000 video, CD-ROM, and video disk programs. Preview copies are available at no charge to qualified educational institutions and public libraries. Contact at: www.films.com
- EPA AirNow web site at www.epa.gov/airnow
 - presents comprehensive air quality maps and forecasts
 - supplies real-time maps of air quality and visibility via webcams
 - displays air quality forecasts for "air action days" in major metropolitan areas around the country
 - provides suggestions on what you can do to help improve the air quality where you live

Suggested Activities

- Environmental Defense Fund (www.environmentaldefense.org) is a national nonprofit organization based in New York City. Since 1967 they have linked science, economics, and law to create innovative, equitable, and cost-effective solutions to the most urgent environmental problems. EDF sponsors the Scorecard website (www.scorecard.org) which is a free and easily accessible source of accessing local environmental information. Simply type in your zip code to learn about environmental issues in your community. Would be useful for helping students complete Assignment Sheets 1 and 2.
- *Air Pollution, What's the Solution.* Provides air quality data and lesson plans. Texas Natural Resource Conservation Commission. Contact at: www.tceq.state.tx.us/index.html

Suggested Lesson Plan

Day 1

Introduction:

- Discuss unit objective, review specific objectives, and explain plan for completing this unit.
- Have students read the introduction.
- Discuss students' viewpoints on importance of air and causes of air pollution.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 2—Composition and percentages of air components (unpolluted).
- Use TM 1 to illustrate the nitrogen cycle.
- Use Teacher Supplement 1—The Nitrogen Cycle—to illustrate the continuous movement of nitrogen from the earth to the atmosphere and back.
- Discuss Objective 3—Importance of air quality.
- Discuss Objective 4—Air pollutants and their characteristics and health hazards.

Closure:

- Review discussion on introductory remarks.
- Review Objective 2.

Evaluation:

- Non-applicable.

Day 2

Introduction:

- Review Objective 3.
- State the objectives for today's lesson.

Delivery and Application:

- Continue discussion of Objective 4.
- Use TM 2 to review air pollutants.
- Assign Assignment Sheet 1—Locate Sources of Air Pollution in Your Area
 - Have students read introduction and directions.
 - Discuss the introduction and directions.
 - Review evaluation criteria.
 - Assign due date for Day 5.
- Discuss Objective 5—Environmental effects of air pollution.
 - a. Greenhouse effect.
- Use TM 3 to illustrate how the greenhouse effect traps solar heat.

Closure:

- Review Assignment Sheet 1.

Evaluation:

- Non-applicable.

Suggested Lesson Plan

Day 3

Introduction:

- Review progress on Assignment Sheet 1.
- Review Objective 5a—Greenhouse effect.
- Use Teacher Supplement 2—Understanding the Greenhouse Effect.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 5b—Acid rain.
- Use TM 4 to illustrate the process for creating acid rain.
- Assign Assignment Sheet 3—Maintain a Weather Log for 10 Days.
 - Have student read introduction and directions.
 - Discuss directions, importance of keeping the log at the same time each day, and how the information will be used when completing Assignment Sheet 4.
 - Assign due date for Day 11.

Closure:

- Review the greenhouse effect.

Evaluation:

- Non-applicable.

Day 4

Introduction:

- Review progress on Assignment Sheets 1 and 3.
- Review Objective 5b—Acid rain.
- Use Teacher Supplement 3—Mixing Acids and Bases to illustrate how acidic emissions may be neutralized.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 5c—Ozone shield.
- Use TM 5 to illustrate the ozone shield and influence of chlorofluorocarbons.
- Discuss Objective 5d—Smog.
- Use TM 6 to illustrate smog over a city.

Closure:

- Remind students that Assignment Sheet 1 is due on Day 5.
- Review acid rain and ozone shield.

Evaluation:

- Non-applicable

Day 5

Introduction:

- Review progress on Assignment Sheet 3.
- Review Objective 5.
- State the objectives for today's lesson.

Suggested Lesson Plan

Day 6

Delivery and Application:

- Have students' present findings for Assignment Sheet 1 to class.
- Discuss findings.
- Turn in Assignment Sheet 1.
- Discuss Objective 6—Indoor air pollution.
- Discuss Objective 7—Indoor air pollutants and their characteristics.

Closure:

- Review Objective 6.
- Be sure to make copies of Teacher Supplement 4 for Day 6 class.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 1 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 1 grade in grade book.
- Record the appropriate competency level on each student's competency profile.

Introduction:

- Return Assignment Sheet 1. Discuss, if necessary.
- Review progress on Assignment Sheet 3.
- State the objectives for today's lesson.

Delivery and Application:

- Continue discussion of Objective 7.
- Use TM 7 to illustrate where indoor air pollutants may be found in the home.
- Discuss Objective 8—Clean Air Act Amendments of 1990.
- Pass out copies of Teacher Supplement 4—Air Pollution in the Past: An Overview.
- Have students read Teacher Supplement 4.
- Discuss highlights of Teacher Supplement 4.
- Assign Assignment Sheet 2—Write a Report on an Environmental Problem Related to Air Quality.
 - Have student read introduction and directions.
 - Discuss directions and evaluation criteria.
 - Assign due date for Day 15.

Closure:

- Review Objective 7.

Evaluation:

- Non-applicable.

Day 7

Introduction:

- Review progress on Assignment Sheets 2 and 3.
- Review Objective 8.
- State the objectives for today's lesson.

Suggested Lesson Plan

Day 8

Delivery and Application:

- Discuss Objective 9—Methods of controlling motor vehicle emissions.
- Discuss Objective 10—Types of pollution control measures that the government may impose on polluters to achieve compliance with environmental regulations.
- Have students read Student Supplement 1—Allowance Trading System to Illustrate Pollution Allowances.
- Discuss Objective 11—Methods of controlling air pollution from industry and electrical power generating plants.
- Allow supervised study for research on Assignment Sheet 2.

Closure:

- Review Objective 9.

Evaluation:

- Non-applicable.

Introduction:

- Review progress on Assignment Sheets 2 and 3.
- Review Objectives 10 and 11 and Student Supplement 1.
- State the objectives for today's lesson.

Delivery and Application:

- Use Teacher Supplement 5—Air Pollution Allowance Trading Game—to illustrate the use of market incentives of cost control which allows sources to make their own decisions for complying with emission limits.

Closure:

- Review progress in air pollution allowance trading game.

Evaluation:

- Non-applicable.

Day 9

Introduction:

- Review progress on Assignment Sheet 2 and 3.
- State the objectives for today's lesson.

Delivery and Application:

- Continue Teacher Supplement 5.
- Allow supervised study on assignment sheet 2 and/or 3, if time permits.

Closure:

- Review results of air pollution allowance trading game.

Evaluation:

- Non-applicable.

Suggested Lesson Plan

Day 10

Introduction:

- Review progress on Assignment Sheet 3. Remind students that assignment sheet is due on Day 11.

Note: The 10-day weather log should end the day before the assignment sheet is due so that compiled information can be used with Assignment Sheet 4.

- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 12—Air quality trends in the United States.
- Discuss Objective 13—Global considerations in air resource management.
- Allow supervised study for completion of Assignment Sheet 3 and research on Assignment Sheet 2.

Closure:

- Review Objective 12.
- Remind students that Assignment Sheet 3 is due on Day 11.

Evaluation:

- Non-applicable.

Day 11

Introduction:

- Review Objective 13.
- Make sure students have completed Assignment Sheet 3.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 14—Factors that cause weather.
- Have students read Student Supplement 2—Understanding the Weather.
- Discuss Student Supplement 2.
- Have students read Student Supplement 3—Forecasting the Weather
- Discuss Student Supplement 2.
- Assign Assignment Sheet 4—Formulate Weather Forecasts.
 - Discuss introduction, directions, and evaluation criteria.
 - Have students use Assignment Sheet 3 to assist in formulating weather forecast for the next 24 to 48 hours.
- Turn in Assignment Sheet 3.
- Have students present their forecasts to class and discuss reasoning behind the forecast.

Closure:

- Review weather forecasts.
- Assignment Sheet 4 will be due on Day 13

Evaluation:

- Evaluate each student's performance on Assignment Sheet 3 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 3 grade in grade book.
- Record the appropriate competency level on each student's competency profile.

Suggested Lesson Plan

Day 12

Introduction:

- Review progress on Assignment Sheet 2.
- Return Assignment Sheet 3. Discuss, if necessary.
- Complete Assignment Sheet 4 weather forecast presentations.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 15—Career opportunities in air resource management.
- Allow supervised study for Assignment Sheets 2 and 4.

Closure:

- Review terms and definitions.
- Remind students of written test on Day 14.

Evaluation:

- Non-applicable.

Day 13

Introduction:

- Turn in Assignment Sheet 4.
- Review unit and specific objectives.
- State the objectives for today's lesson.

Delivery and Application:

- Have students complete Air Resource Management Review during class.
- Provide supervised study for Assignment Sheet 2 and written test.

Closure:

- Turn in completed review.
- Remind student of written test on Day 14.

Evaluation:

- Evaluate each student's performance on Air Resource Management Review according to answer key.
- Record student's review grade in grade book.
- Evaluate each student's performance on Assignment Sheet 4 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 4 grade in grade book.
- Record the appropriate competency level on each student's competency profile.

Day 14

Introduction:

- Return Assignment Sheet 4. Discuss, if necessary.
- Return Air Resource Management Review. Discuss, if necessary.
- Review for written test.
- State the objectives for today's lesson.

Delivery and Application:

- Have students take written test on unit objectives.
- Have students that have completed written test work on Assignment Sheet 2.

Suggested Lesson Plan

Day 15

Closure:

- Review expectations and evaluation criteria for Assignment Sheet 2.

Evaluation:

- Evaluate student performance on written test using answer key.
Note: Develop teaching strategies for students who did not achieve minimum criteria.
- Record written test grade in grade book.
- Record written test score on each student's competency profile.

Introduction:

- Return students' written test and review answers.
- Discuss strategies for students' who did not achieve the minimum criteria on the written test.
- State the objectives for today's lesson.

Delivery and Application:

- Have students complete Assignment Sheet 2.
- Discuss findings of Assignment Sheet 2, including selected environmental problems, causes of problem, possible solutions, and future outlook.

Closure:

- Turn in Assignment Sheet 2. (Turn back to students at next class.)
- Review unit objective.
- Review next lesson.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 2 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 2 grade in grade book.
- Record the appropriate competency level on each student's competency profile.

Air Resource Management Review

Name _____ Overall Rating _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate serious effort was taken in completing review	_____

Introduction

Air is all around us. We breathe it and live in it. We can damage air with pollution and could even make it unusable. Managing and maintaining good, clean air is important to all living things.

Directions

Answer the following questions concerning air resource management. For help, refer to the information sheets and student supplements in this unit. Circle the correct response for each question.

1. A mixture of invisible, odorless, and tasteless gases that surround the earth is called:
 - a. Atmosphere
 - b. Air
 - c. Ambient air
 - d. Weather
2. Pollution is:
 - a. The presence of matter or energy whose nature, location, or quantity produces undesirable environmental effects.
 - b. Any introduced gas, liquid, or solid that makes a resource unfit for a specific purpose.
 - c. The suitability of the air for use by living organisms.
 - d. The current condition of the atmosphere including temperature, wind, moisture, and atmospheric pressure.
3. Unpolluted air is composed primarily of:
 - a. Oxygen
 - b. Argon
 - c. Carbon dioxide
 - d. Nitrogen

Review

4. What federal agency is responsible for establishing and maintaining air quality standards for the maximum amount of pollution that can be in ambient air?
 - a. Occupational Safety and Health Administration
 - b. United States Department of Agriculture
 - c. Environmental Protection Agency
 - d. U.S. Department of Health, Education, and Welfare
5. Particulate matter is:
 - a. A heavy, pungent, colorless gas.
 - b. An invisible gas.
 - c. A colorless, odorless, highly toxic gas.
 - d. Finely divided solid or liquid particles in the air or in an emission.
6. Ozone (O_3) is:
 - a. Produced by incomplete fossil fuel combustion.
 - b. Formed through the burning of coal, fuel oils, and wood.
 - c. Produced when sunlight hits air pollutants.
 - d. Caused by all types of burning and/or agricultural practices.
7. The greenhouse effect:
 - a. Traps heat from the sun and radiates part of it back to the atmosphere.
 - b. Is atmospheric moisture which absorbs acid particles and falls to the earth.
 - c. Is a layer of ozone in the stratosphere 6 to 30 miles above the earth.
 - d. Causes surface waters and soils to become more acidic.
8. Smog is:
 - a. Finely divided solid or liquid particles in the air.
 - b. A combination of smoke and fog forming an atmosphere polluted with industrial emissions and automobile exhaust.
 - c. A heavy, pungent, visible gas.
 - d. A filter that protects all earth organisms from dangerous ultraviolet radiation from the sun.
9. A long-term health effect of indoor air pollution is:
 - a. Eye, ear, nose, and throat irritations
 - b. Headaches
 - c. Permanent respiratory damage
 - d. Nausea

10. Most people spend _____ percent of their time indoors.
 - a. 90
 - b. 75
 - c. 50
 - d. 25
11. Radon is:
 - a. A mineral fiber found in nature which is normally used for insulation.
 - b. A naturally occurring gas emitted from radioactive decay of the element radium.
 - c. Found in furniture, foam insulation, and pressed wood products.
 - d. A chemical used to destroy pests.
12. It is estimated that from 500 to _____ nonsmoker deaths per year are linked to environmental tobacco smoke.
 - a. 750
 - b. 1000
 - c. 600
 - d. 1 500
13. Biological contaminants can cause:
 - a. Heart disease, lung cancer, and other health disorders.
 - b. Viral infections and allergic reactions.
 - c. Eye and nose irritation.
 - d. Lung cancer.
14. What federal legislation brought significant and wide-ranging changes dealing with all kinds of air pollution?
 - a. Air Pollution Control Act of 1955.
 - b. Air Quality Act of 1967.
 - c. Clean Air Act Amendments of 1990.
 - d. United States National Air Pollution Conference held in 1949.
15. A method of controlling motor vehicle emissions is:
 - a. Stop burning coal or wood.
 - b. Use only lead gasoline.
 - c. Use only fossil fuels.
 - d. Use only lead-free gasoline.

Review

16. Point source air pollution is:
 - a. The maximum level of atmospheric pollution allowed at one time in a geographical area.
 - b. The air or atmosphere outside.
 - c. A specific place where air pollution originates.
 - d. A standard limiting the amount of pollution allowed in the air.
17. The decrease in atmospheric carbon monoxide is due largely to:
 - a. Emission control devices on motor vehicles.
 - b. Pollution control devices installed on coal-fired plants.
 - c. Removal of lead from gasoline.
 - d. Pollution control devices on sources of particulates.
18. The "weight" of a high pressure system, and the air around it, can be measured with an instrument called a:
 - a. Wind vane
 - b. Rain gauge
 - c. Thermometer
 - d. Barometer
19. The current condition of the atmosphere including temperature, wind, moisture, and atmospheric pressure.
 - a. Air
 - b. Air quality standards
 - c. Weather
 - d. Weather forecast
20. A TV or radio personality who forecasts the weather is called a:
 - a. Air quality engineer
 - b. Meteorologist
 - c. Environmental scientist
 - d. Tornado chaser

Air Resource Management Review—Answer Key

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate serious effort was taken in completing review	_____

1. A mixture of invisible, odorless, and tasteless gases that surround the earth is called:
 - a. **Atmosphere**
 - b. Air
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2. Pollution is:
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 - b. Any introduced gas, liquid, or solid that makes a resource unfit for a specific purpose.
 - c. The suitability of the air for use by living organisms.
 - d. The current condition of the atmosphere including temperature, wind, moisture, and atmospheric pressure.
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 - b. Argon
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Review—Answer Key

4. What federal agency is responsible for establishing and maintaining air quality standards for the maximum amount of pollution that can be in ambient air?
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 - c. Environmental Protection Agency**
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 - a. Traps heat from the sun and radiates part of it back to the atmosphere.**
 - b. Is atmospheric moisture which absorbs acid particles and falls to the earth.
 - c. Is a layer of ozone in the stratosphere 6 to 30 miles above the earth.
 - d. Causes surface waters and soils to become more acidic.
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 - a. Finely divided solid or liquid particles in the air.
 - b. A combination of smoke and fog forming an atmosphere polluted with industrial emissions and automobile exhaust.**
 - c. A heavy, pungent, visible gas.
 - d. A filter that protects all earth organisms from dangerous ultraviolet radiation from the sun.
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 - a. Eye, ear, nose, and throat irritations
 - b. Headaches
 - c. Permanent respiratory damage**
 - d. Nausea

Review—Answer Key

10. Most people spend _____ percent of their time indoors.
- a. **90**
 - b. 75
 - c. 50
 - d. 25
11. Radon is:
- a. A mineral fiber found in nature which is normally used for insulation.
 - b. **A naturally occurring gas emitted from radioactive decay of the element radium.**
 - c. Found in furniture, foam insulation, and pressed wood products.
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 - c. **Clean Air Act Amendments of 1990.**
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15. A method of controlling motor vehicle emissions is:
- a. Stop burning coal or wood.
 - b. Use only lead gasoline.
 - c. Use only fossil fuels.
 - d. **Use only lead-free gasoline.**

Review—Answer Key

16. Point source air pollution is:
- a. The maximum level of atmospheric pollution allowed at one time in a geographical area.
 - b. The air or atmosphere outside.
 - c. **A specific place where air pollution originates.**
 - d. A standard limiting the amount of pollution allowed in the air.
17. The decrease in atmospheric carbon monoxide is due largely to:
- a. **Emission control devices on motor vehicles.**
 - b. Pollution control devices installed on coal-fired plants.
 - c. Removal of lead from gasoline.
 - d. Pollution control devices on sources of particulates.
18. The "weight" of a high pressure system, and the air around it, can be measured with an instrument called a:
- a. Wind vane
 - b. Rain gauge
 - c. Thermometer
 - d. **Barometer**
19. The current condition of the atmosphere including temperature, wind, moisture, and atmospheric pressure.
- a. Air
 - b. Air quality standards
 - c. **Weather**
 - d. Weather forecast
20. A TV or radio personality who forecasts the weather is called a:
- a. Air quality engineer
 - b. **Meteorologist**
 - c. Environmental scientist
 - d. Tornado chaser

Answers to Assignment Sheets**Assignment
Sheet 1****Locate Sources of Air Pollution in Your Area**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 2****Write a Report on an Environmental Problem Related to Air Quality**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 3****Maintain a Weather Log for 10 Days**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 4****Formulate Weather Forecasts**

Student performance should be evaluated according to criteria listed on the assignment sheet.

Teacher Supplement 1—The Nitrogen Cycle

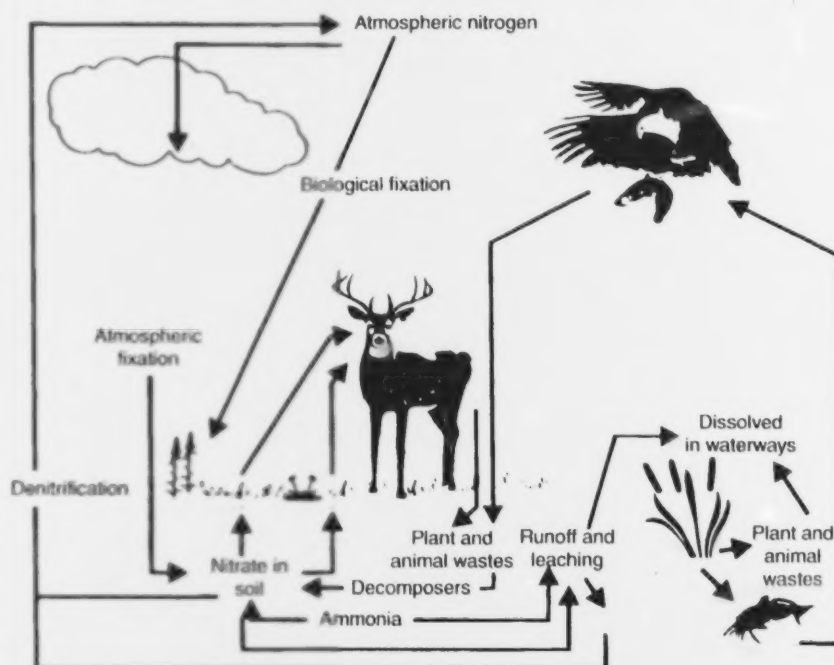
Purpose

The nitrogen cycle illustrates the continuous movement of nitrogen from the earth to the atmosphere and back.

The nitrogen cycle is a natural process for using oxygen.

- Organisms circulate nitrogen through the atmosphere, soil and water.
 - Decomposers in the soil act on decaying plants and animals and release nitrogen.
 - The nitrogen gas is released back into the atmosphere.
 - Rain and other precipitation return the nitrogen to the earth for use by plants.
- Note: Plants can not use the gaseous nitrogen form.
- Nitrogen fixing bacteria convert the gaseous nitrogen to nitrates that plants can use.
 - Nitrogen in water also undergoes a similar cycle.

The Nitrogen Cycle



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**Teacher Supplement 2—Understanding
the Greenhouse Effect****Purpose**

To stimulate the greenhouse effect and understand the possible consequences of the greenhouse effect. Students should gain an understanding that the cover in the experiment represents the heat-absorbing quality of the greenhouse gases like carbon dioxide, nitrogen dioxide, and methane.

**Materials
Needed**

- Two identical large glass jars, or two large beakers, or two small aquariums or two plastic boxes with one cover
- Two thermometers
- Two desk lamps or two heat lamps
- Soil or sand to cover the bottom of the containers
- Watch or clock

Procedures

1. Place the soil or sand on the bottom of the containers to represent the Earth.
2. Place the thermometer in the containers resting on the soil or sand propped upon the side of the container.
3. Place the two lamps an inch away from the two containers at the same height.
4. Cover one container with a lid to represent the greenhouse effect and leave the other container uncovered to represent the absence of the greenhouse effect.
5. Record the temperature reading of both thermometers before turning on the lamps.
6. Turn on both lights and record the temperature reading of both thermometers every minute for 20 minutes.
7. Record the temperatures of both containers on the temperature chart.
8. Graph the two containers' changes of temperature on the graph.

Questions

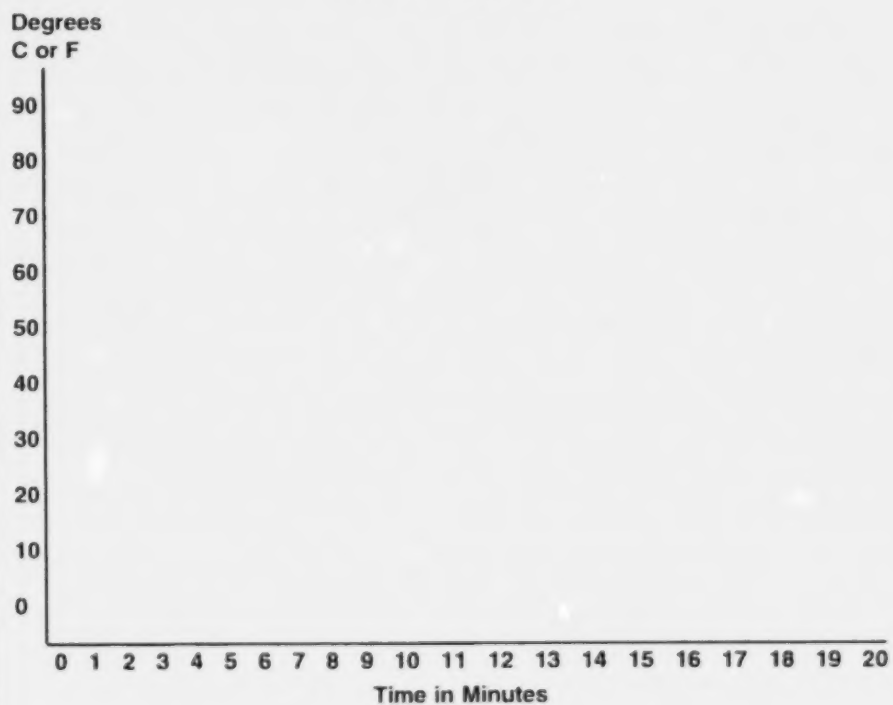
- Which container had the greatest temperature increase? Why?
- How could the greenhouse effect cause a similar temperature increase in the Earth's climate?
- What can be done to reduce the chances of having a greenhouse effect cause a global climate change?

Teacher Supplement 2

Temperature Chart

Time in Minutes	Temperature in C or F Covered Container (Greenhouse Effect)	Temperature in C or F Uncovered Container (Absence of Greenhouse Effect)
Start 0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Temperature Graph



Teacher Supplement 3—Mixing Acids and Bases**Purpose**

This activity will provide a practical exercise in understanding how to measure acids and bases and to measure the change in pH as neutralization takes place.

Materials Needed

- Baby food jars or glass containers
- Indigestion tablets
- Egg shells
- Baking soda
- Lemon juice
- Vinegar
- pH indicator paper
- 1/2 cup measuring cup
- Medicine dropper (optional)

Procedure

1. Check to make sure there is good ventilation.
2. Make a chart to record the pH of materials and the interactions with other materials
3. Experiment #1:
 - Pour 1/2 cup of vinegar in a glass container.
 - Measure the vinegar's pH level with pH indicator paper.
 - Record your findings on the chart.
 - Pour 1/2 cup of water into a glass container.
 - Place an indigestion tablet into the water until dissolved.
 - Slowly pour the vinegar into the indigestion-tablet solution.
 - Measure the resulting pH level.
 - Record your findings on the chart.

Questions:

- What happened to the pH level of the vinegar?
- What is the medicinal purpose of the indigestion tablets?
- Would the pH of the mixture be different if various amounts of vinegar were used?
- How might this apply to lakes in regions where acid rain occurs?

4. Experiment #2:

- Pour 1/2 cup of vinegar into three clean glass containers.
- Add the following:
 - Egg shells
 - Baking soda
 - Lemon juice
- Measure the resulting pH level for each combination (vinegar/egg shells; vinegar/baking soda; and vinegar/lemon juice).
- Record your findings on the chart

Questions:

- What happened to the pH level of the vinegar? Why?
- Why were the results different (if any)?
- How might these results apply to reduction of acidic emissions?

**Teacher Supplement 4—Air Pollution in the Past:
An Overview****Introduction**

Humans probably first experienced harm from air pollution from natural resources such as volcano eruptions or when they built fire in poorly ventilated caves. As cities began to grow, during the agricultural revolution, air pollution from the burning of wood became a problem. During the industrial revolution, of the late 1700's in Europe and early 1800's in the United States, the burning of coal became a serious problem. Listed below are selected historic events involving air pollution.

- 1273 King Edward I of England banned the burning of coal in order to reduce air pollution.
- 1580 Queen Elizabeth banned the use of coal for heating buildings when Parliament was in session.
- 1819 English Parliament appointed a committee to study smoke in the atmosphere.
- 1853 British Parliament gave police power to control smoke in London.
- 1880 Many British cities passed regulations to curtail smoke.
- 1911 London, England. 1,150 London citizens died from the effects of coal smoke. The term "smog" was coined for the mixture of smoke and fog that often hung over London.
- 1911 Glasgow, Scotland. Smog pollutants from coal burning resulted in more than 1,000 deaths.
- 1920 Surveys of atmospheric contamination were made in New York City and Salt Lake City.
- 1930 Meuse Valley, Belgium. Stagnant air is unable to dilute industrial pollution; over 60 deaths are attributed to smog.
- 1948 Donora, Pennsylvania. Fog laden with sulfur dioxide vapor and suspended particulate matter stagnated over Donora for five days. About 6,000 of the town's inhabitants fell ill and 20 died. This killer fog resulted from a combination of mountainous terrain surrounding the valley and stable weather conditions that trapped and concentrated pollutants emitted by the community's steel mill, zinc smelter, and sulfuric acid plant.
- 1949 The first United States National Air Pollution Conference was held.

Teacher Supplement 4

- 1950 Acid rain found in Northwestern England.
- 1952 London, England. Smog pollutants from coal cause an estimated 4,000 deaths.
- 1955 The United States passes first air pollution control act.
- 1956 Great Britain enacts its Clean Air Act.
- 1959 First International Air Pollution Conference is held in London.
- 1960 Studies increased on the effect of carbon dioxide in creating the greenhouse effect.
- 1963 New York City. High concentrations of air pollutants accumulated in air over the city, killing about 300 people and injuring thousands. Other episodes during the 1960s in New York City, Los Angeles, and other larger cities led to much stronger air pollution control programs in the 1970s.
- 1963 Clean Air Act of 1963 authorized the U.S. Public Health Service to study air pollution and provided grants and training for states to control it.
- 1964 Canadian lakes studied for the effects of acid rain.
- 1967 Air Quality Act of 1967. Federal government assumes more responsibility for air pollution control in states that failed to enforce air quality standards.
- 1970 Clean Air Act Amendments of 1970. The responsibility of prevention, control, abatement, and administration of the air pollution program is removed from the Department of Health, Education, and Welfare, and placed in newly created Environmental Protection Agency. Increased research funds, noise pollution, control of 14 selected toxic emissions and enforcement of emissions limitations through criminal penalties and injunctions became provisions of the law. The key issue was the establishment of ambient air quality standards and performance standards for coal-fired power plants. These standards became known as the New Source Performance Standards (NSPS).
- 1980s Mexico City, Mexico. The city, considered to have the worst air in the world, exceeded safety limits for ozone for 310 days in 1988, with values more than 300% over norms set by the World Health Organization. In 1989, the government closed schools for a month to lessen the exposure of school children to city air. A study showed that 40% of young children suffer chronic respiratory sickness during winter months due to thermal inversions.

Studies were made of acidification of streams and lakes in the United States. Other studies are carried out to determine if acid rain had caused a decline of coniferous forests in the United States and Europe.

Measurements were made of the increase in carbon dioxide in the atmosphere owing to the burning of fossil fuels and the world's forests.

1985 British scientists find a major decline of ozone over Antarctica. CFCs are suspected.

1987 Twenty-four nations agreed, in a treaty called Montreal Protocol, to ban CFC production. The United States and 45 other nations joined shortly afterward.

1990 Clean Air Act Amendments of 1990. These amendments brought wide-ranging changes, dealing with all kinds of pollution, from large or small, mobile or stationary sources, including routine and toxic emissions, ranging from power plants to consumer products. It targeted several specific areas;

- Acid Rain: Reductions by half of sulfur dioxides and nitrogen oxides.
- Urban Smog: Established targets for cities that do not meet limits on ozone (a key ingredient in smog). These cities, called non-attainment areas, have specific phased-in targets to be met.
- Automobile Emissions: Set specific targets for reduction of tailpipe emissions of hydrocarbons. Required longer lasting pollution control equipment on cars. Encouraged cleaner kinds of gasoline such as gasohol in cities with the worst carbon monoxide problems. Mandated development of automobiles meeting even stricter standards in extremely pollution prone cities like Los Angeles.
- Toxic Air Pollutants: Expanded the number of regulated toxic air pollutants from 7 to 189. Set new safety standards for residents living near polluters. Required polluters to install the best available pollution control equipment. The aim was to reduce toxic emissions by 90 percent by the year 2003.
- Depletion of the Ozone Layer: Phased out destruction of ozone destroying chemicals throughout the 1990s, including CFCs, methyl chloroform, and carbon tetrachloride. Established rules for recycling and disposal of such chemicals.
- Compensation: Provided a program to provide compensation for workers displaced as businesses conformed to the new law.

Teacher Supplement 4

- 2001 New York City. Thousands of injuries due to air pollution from terrorists' attack on World Trade Center buildings.
- 2002 California legislators passed a bill that would reduce global warming by mandating stricter greenhouse gas emissions controls for automobiles.
- 2003 Proposed Clear Skies Act. Would create a mandatory program that would reduce power plant emissions of sulfur dioxide (SO₂) and nitrogen oxides (NO_x)

Note: Air pollution, clean air, and air quality information is provided by the U.S. Environmental Protection Agency's Office of Air and Radiation (OAR). OAR develops national programs, technical policies, and regulations for controlling air pollution and radiation exposure. OAR is concerned with air pollution, indoor and ambient air quality, industrial air pollution, pollution from vehicles and engines, radon, acid rain, stratospheric ozone depletion, and radiation protection. Contact at: www.epa.gov/air

Teacher Supplement 5—Air Pollution Allowance Trading Game

Purpose	• To recognize the costs of pollution abatement and how costs are allocated and can be shared • To decide how to allocate scarce resources • To recognize the benefits of free market trading in pollution abatement (rewarding good behavior)
Materials Needed	• Scratch paper • 6 calculators (one for each group) • Air Pollution Glossary (one for each student) • Air Pollution Allowance Trading Game Rules (one for each student) • Student Group Worksheets 1-6 (Each Group Worksheet is different.)
Procedures	1. Divide the class into six groups. • Number each group. 2. Distribute facts and conditions. • Air Pollution Glossary (one per group member) • Air Pollution Allowance Trading Game Rules (one per group member) • Appropriate scoring sheet for group (labeled Group 1, Group 2, and so forth) 3. Review the Air Pollution Glossary. • Use Air Pollution Glossary Quiz to measure understanding. 4. Explain the concepts and rules of the game. • Read the Air Pollution Allowance Trading Game Rules with students. • Point out that the goal of the game is to make the most money through trading and saving of pollution allowances. • Remind students that the game will be played for five rounds. A round represents one year. Each year they will receive a number of allowances that may increase or decrease, but they do not know what those changes will be. • Review "To recap". 5. Have each group read the facts at the top of their group's Student Group Worksheet. 6. For the first round: • Have the groups complete questions 1 through 3 on their worksheet. Note: After completing questions 1 through 3, each group will have to make three decisions: — Whether to buy or sell allowances — Whether to pay for pollution abatement technology — Whether to bank allowances or pay fines Remind the groups that pollution abatement technology is permanent and will carry over year to year. • Tally the number of allowances that are available from all groups. • Have groups complete question 4. • Re-tally the number of allowances available. • Commence the trading of allowances through the auctioning of allowances. Note: The teacher or a student may act as auctioneer.

Teacher Supplement 5

Suggestions

- Have groups answer remaining questions.
Note: If allowances are bought and sold, ask how much does an allowance cost and why.
 - 7. For the second round:
 - Each group will again receive ten allowances.
 - Repeat the steps from the previous round.
Note: Make sure they carry over any banked allowances and take into account units of technology purchases.
 - Ask the question: Has the price of an allowance changed? Why?
 - 8. For the third round:
 - Each group receives only eight allowances.
Note: Do not let students know this change is coming.
 - Repeat the steps from the previous round.
 - Double check to make sure students are recording changes in allowance prices, technology purchasing patterns, fines paid out, and allowance banking.
 - 9. For the fourth round:
 - Each group receives 11 allowances.
 - Repeat steps from the previous round.
 - 10. For the fifth round:
 - Each group receives 10 allowances.
 - Repeat steps from the previous round.
 - 11. Determine the winning group based on the value of allowances in hand minus fines paid.
 - 12. Have students discuss the results.
 - Who did the best? Why?
 - At the beginning of the game, Group 5 was in the best position. Did they maintain their lead?
 - How did group 4 fare? Why?
 - Compare groups 1 and 2, who began on even footing. Did one group do better than the other? Why?
 - 13. Have students discuss the usefulness of an allowance trading system.
 - Why should there be incentives to reduce emissions through the use of pollution reduction technology?
 - Why the total number of allowances distributed for the first round was less than the total amount of emissions?
 - How and why were fines built into the game from the onset?
-
- Teachers should feel free to alter the facts. For example, the price of pollution abatement technology may change from year to year, or fines may change. The results need only reflect the current conditions and prices, and some results may be "unreasonable."
 - Have students consider alternatives to this system and consider the choices they would face and make if they were the regulator. Focus class discussion on the topic or have students prepare and deliver oral presentations about their ideas.

Adapted from: *Project AIRE: Air Information Resources for Education (K-12)*, Washington, D.C., United States Environmental Protection Agency, 1994.

Teacher Supplement 5

Air Pollution Glossary

This vocabulary should be mastered for the following activity: Air Pollution Allowance Trading Game.

- **Abatement**—To remove, reduce, or decrease in degree or amount
- **Allowance**—An amount of pollution that may be emitted before the allowance is used
Example: one ton of pollutant
- **Bank**—To save unused air pollution allowances for a period that may be carried over into the next period
- **Clean Air Act**—The legislation, originally enacted in 1963, revised in 1970, and amended in 1990, which is the basis for the national air pollution control program
- **Compliance**—The full implementation requirements, standards, or regulations
- **Compliance Monitoring**—Periodic or continuous surveillance or testing to determine whether a factory or facility is complying with statutory requirements for limiting air particulates or other pollutants
- **Deterrence**—An action or measures adopted to discourage people or companies from violating regulations or requirements
- **Discharge**—A release of pollutants into the air
- **Permit**—An authorization, license, or equivalent control document issued by the federal, state, or local government to implement the requirements of a regulation
Example: The 1990 Clean Air Act introduced a nation-wide permit system for air pollution control that requires permits for both the operation of power plants or other facilities and for construction of new plants or facilities. The proposed 2003 Clean Skies Act may further facilitate this system.
- **Point Source**—A discrete, stationary source of pollution, such as a power plant, factory, or gas station
- **Regulations**—Rules that federal and local governments issue to govern how individuals and business may act or operate
- **Restitution**—A return to a previous state or position
- **Retribution**—The dispensing or receiving of punishment in compensation for an act perceived to be harmful to others
- **Standards**—In the context of the Clean Air Act, a containment level established by EPA above which a containment presents unacceptable health or environmental risks

Teacher Supplement 5

Air Pollution Glossary Quiz

Match the vocabulary word with its definition from the Trading Game glossary. Write the corresponding letter on the blank provided.

- | | |
|-----------------------------|---|
| _____ Clean Air Act | a. To remove, reduce, or decrease in degree or amount |
| _____ Deterrence | b. An amount of pollution (for example, one ton of pollutant) that may be emitted before the allowance is used |
| _____ Bank | c. To save unused air pollution allowances for a period that may be carried over into the next period |
| _____ Permit | d. The legislation, originally enacted in 1963, revised in 1970, and amended in 1990, which is the basis for the national air pollution control program |
| _____ Standards | e. The full implementation requirements, standards, and regulations |
| _____ Restitution | f. Periodic or continuous surveillance or testing to determine whether a factory or facility is complying with statutory requirements for limiting air particulates or other pollutants |
| _____ Discharge | g. An action or measures adopted to discourage people or companies from violating regulations or requirements |
| _____ Compliance | h. A release of pollutants into the air |
| _____ Abatement | i. An authorization, license, or equivalent control document issued by the federal, state, or local government to implement the requirements of a regulation |
| _____ Point Source | j. A discrete, stationary source of pollution, such as a power plant, factory, or gas station |
| _____ Regulations | k. Rules that federal and local governments issue to govern how individuals and businesses may act or operate |
| _____ Compliance Monitoring | l. A return to a previous state or position |
| _____ Allowance | m. The dispensing or receiving of punishment in compensation for an act perceived to be harmful to others |
| _____ Retribution | n. In the context of the Clean Air Act, a containment level established by EPA above which a contaminant presents unacceptable health or environmental risks |

Air Pollution Glossary Quiz—Answer Key

- | | |
|--------------------------------|---|
| <u>D</u> Clean Air Act | a. To remove, reduce, or decrease in degree or amount |
| <u>G</u> Deterrence | b. An amount of pollution (for example, one ton of pollutant) that may be emitted before the allowance is used |
| <u>C</u> Bank | c. To save unused air pollution allowances for a period that may be carried over into the next period |
| <u>I</u> Permit | d. The legislation, originally enacted in 1963, revised in 1970, and amended in 1990, which is the basis for the national air pollution control program |
| <u>N</u> Standards | e. The full implementation requirements, standards, and regulations |
| <u>L</u> Restitution | f. Periodic or continuous surveillance or testing to determine whether a factory or facility is complying with statutory requirements for limiting air particulates or other pollutants |
| <u>H</u> Discharge | g. An action or measures adopted to discourage people or companies from violating regulations or requirements |
| <u>E</u> Compliance | h. A release of pollutants into the air |
| <u>A</u> Abatement | i. An authorization, license, or equivalent control document issued by the federal, state, or local government to implement the requirements of a regulation |
| <u>J</u> Point Source | j. A discrete, stationary source of pollution, such as a power plant, factory, or gas station |
| <u>K</u> Regulations | k. Rules that federal and local governments issue to govern how individuals and businesses may act or operate |
| <u>F</u> Compliance Monitoring | l. A return to a previous state or position |
| <u>B</u> Allowance | m. The dispensing or receiving of punishment in compensation for an act perceived to be harmful to others |
| <u>M</u> Retribution | n. In the context of the Clean Air Act, a containment level established by EPA above which a contaminant presents unacceptable health or environmental risks |

Teacher Supplement 5

Air Pollution Allowance Trading Game Rules

Group # _____

Team members:

-
-
-
-

Evaluation Criteria	Rating
• Defined the terms on the Air Pollution Glossary	_____
• Actively participated in the game	_____
• Completed the work sheets	_____
• Participated in the discussion on the usefulness of an allowance trading system	_____

- Each group has been given a role and an individual set of facts outlining the rules and circumstances going into the pollution allowance trading game. Each group represents a public utility that emits air pollution; however, the government limits the amount each utility can emit. A group will be penalized for exceeding air pollution limits. For each round of the game, each group will receive a certain number of air pollution allowances that represent a portion of the amount of pollution they are allowed to emit. If a group does not use up all its allowances, it can trade or bank remaining allowances.

Example: If a group receives five allowances, and each allowance permits 1,000 tons of pollution, then the group's factory can emit 5,000 tons of pollution. Any excess would be subject to a fine. If the group's factory only emits 3,000 tons of pollution, it will only use up three of its allowances, and then may sell or bank the other two. If the group's factory emits 7,000 tons of pollution, it will be penalized unless it purchases extra allowances or has banked allowances.

- There will be five rounds of trading. Each round represents one year. At the beginning of each round, each group will receive an allocation of allowances. For each round, the number of allowances received will be the same number for each group; however, the number of allowances may increase or decrease from round to round. Extra allowances banked during one round may be used during subsequent rounds.

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- In addition to deciding whether to buy, sell, or bank allowances, a group may also decide to purchase pollution reduction technology. Technology units cost \$2,000. Each technology unit provides 500 tons of annual pollution reduction. Technology units reduce pollution beginning in the year they are purchased and will continue to provide pollution reduction in subsequent rounds. A group cannot emit less than 5,000 tons of pollution per year.
- An allowance permits the emission of 1,000 tons of air pollution. The penalty for exceeding the allowance limit is \$1 per ton per year.
- To recap:
 - Five rounds of trading
 - Allowances are distributed at the beginning of each round
 - An allowance permits 1,000 tons of air pollution
 - Extra allowances may be bought, sold, or banked
 - Penalties = \$1 per ton of air pollution in excess of allowances
 - Pollution reduction technology costs \$2,000 per unit
 - Pollution reduction technology reduces pollution by 500 tons of air pollution per year and is permanent
 - A group cannot emit less than 5,000 tons of air pollution per year

Teacher Supplement 5

Air Pollution Allowance Trading Game Group 1

You are a coal-burning electric power utility with a single power plant. You have received 10 pollution allowances for the first year. The number of allowances you will receive in future rounds is unknown. Based on your current projections, you will emit 10,000 tons of pollution annually in the coming 5 years.

1. Calculate your pollution emission allowance for the year.

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

2. Do you have any allowances for the year (is your annual pollution emission less than your total allowances in hand)?

a) NO, skip to question 3

b) YES, how many? (You may skip question 3)

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

3. Did you exceed your allowances (is your annual pollution emission greater than your total allowances in hand)?

a) YES, How many extra allowances do you need?

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

b) Calculate any penalties you will pay if you are not able to purchase extra allowances.

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

c) How much would you be able to pay for an allowance? Divide the penalty amount by the number of allowances you need.

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

The auctioneer (your teacher) will now tally the number of allowances available.

4. Before trading begins, would you like to purchase pollution control technology? If yes, how many units?

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

Recalculate your annual pollution emissions.

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

The auctioneer will now re-tally the number of allowances available. Now begin trading. Some groups have extra allowances that they may wish to sell, while others will be paying fines if they do not acquire extra allowances. Note that groups with extra allowances do not have to sell them if the selling price is not high enough. They can bank them for use or sale in later rounds.

5. How did your group end up at the end of the year (+ or -)? (include money received for extra allowances sold, money paid in penalties or for extra allowances needed, money paid for pollution reduction technology, and the number of allowances banked.

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

6. What is the current price of an allowance?

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

Now go on to the next round. Your teacher will tell you the number of allowances each group will receive. Remember that this number may go up or down. For each round, fill in the above worksheet, recording the results of each round of trading. Be sure to keep track of your current account: the amount (+ or -) that your group has earned or spent.

Air Pollution Allowance Trading Game
Group 2

You are a coal-burning electric power utility with a single power plant. You have received 10 pollution allowances for the first year. The number of allowances you will receive in future rounds is unknown. Based on your current projections, you will emit 10,000 tons of pollution annually in the coming 5 years.

1. Calculate your pollution emission allowance for the year.

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

2. Do you have any allowances for the year (is your annual pollution emission less than your total allowances in hand)?

a) NO, skip to question 3

b) YES, how many? (You may skip question 3)

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

3. Did you exceed your allowances (is your annual pollution emission greater than your total allowances in hand)?

a) YES, How many extra allowances do you need?

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

b) Calculate any penalties you will pay if you are not able to purchase extra allowances.

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

c) How much would you be able to pay for an allowance? Divide the penalty amount by the number of allowances you need.

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

The auctioneer (your teacher) will now tally the number of allowances available.

4. Before trading begins, would you like to purchase pollution control technology? If yes, how many units?

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

Recalculate your annual pollution emissions.

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

The auctioneer will now re-tally the number of allowances available. Now begin trading. Some groups have extra allowances that they may wish to sell, while others will be paying fines if they do not acquire extra allowances. Note that groups with extra allowances do not have to sell them if the selling price is not high enough. They can bank them for use or sale in later rounds.

5. How did your group end up at the end of the year (+ or -)? (include money received for extra allowances sold, money paid in penalties or for extra allowances needed, money paid for pollution reduction technology, and the number of allowances banked.

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

6. What is the current price of an allowance?

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

Now go on to the next round. Your teacher will tell you the number of allowances each group will receive. Remember that this number may go up or down. For each round, fill in the above worksheet, recording the results of each round of trading. Be sure to keep track of your current account: the amount (+ or -) that your group has earned or spent.

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Air Pollution Allowance Trading Game Group 3

You are a coal-burning electric power utility with a single power plant. You have received 10 pollution allowances for the first year. The number of allowances you will receive in future rounds is unknown. Based on your current projections, you will emit 9,000 tons of pollution annually in the coming 5 years.

1. Calculate your pollution emission allowance for the year.

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

2. Do you have any allowances for the year (is your annual pollution emission less than your total allowances in hand)?

a) NO, skip to question 3

b) YES, how many? (You may skip question 3)

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

3. Did you exceed your allowances (is your annual pollution emission greater than your total allowances in hand)?

a) YES, How many extra allowances do you need?

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

b) Calculate any penalties you will pay if you are not able to purchase extra allowances.

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

c) How much would you be able to pay for an allowance? Divide the penalty amount by the number of allowances you need.

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

The auctioneer (your teacher) will now tally the number of allowances available.

4. Before trading begins, would you like to purchase pollution control technology? If yes, how many units?

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

Recalculate your annual pollution emissions.

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

The auctioneer will now re-tally the number of allowances available. Now begin trading. Some groups have extra allowances that they may wish to sell, while others will be paying fines if they do not acquire extra allowances. Note that groups with extra allowances do not have to sell them if the selling price is not high enough. They can bank them for use or sale in later rounds.

5. How did your group end up at the end of the year (+ or -)? (include money received for extra allowances sold, money paid in penalties or for extra allowances needed, money paid for pollution reduction technology, and the number of allowances banked.

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

6. What is the current price of an allowance?

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

Now go on to the next round. Your teacher will tell you the number of allowances each group will receive. Remember that this number may go up or down. For each round, fill in the above worksheet, recording the results of each round of trading. Be sure to keep track of your current account: the amount (+ or -) that your group has earned or spent.

Air Pollution Allowance Trading Game
Group 4

You are a coal-burning electric power utility with a single power plant. You have received 10 pollution allowances for the first year. The number of allowances you will receive in future rounds is unknown. Based on your current projections, you will emit 16,000 tons of pollution annually in the coming 5 years.

1. Calculate your pollution emission allowance for the year.
Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____
2. Do you have any allowances for the year (is your annual pollution emission less than your total allowances in hand)?
a) NO, skip to question 3
b) YES, how many? (You may skip question 3)
Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____
3. Did you exceed your allowances (is your annual pollution emission greater than your total allowances in hand)?
a) YES, How many extra allowances do you need?
Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____
b) Calculate any penalties you will pay if you are not able to purchase extra allowances.
Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____
c) How much would you be able to pay for an allowance? Divide the penalty amount by the number of allowances you need.
Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

The auctioneer (your teacher) will now tally the number of allowances available.

4. Before trading begins, would you like to purchase pollution control technology? If yes, how many units?
Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____
Recalculate your annual pollution emissions.
Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

The auctioneer will now re-tally the number of allowances available. Now begin trading. Some groups have extra allowances that they may wish to sell, while others will be paying fines if they do not acquire extra allowances. Note that groups with extra allowances do not have to sell them if the selling price is not high enough. They can bank them for use or sale in later rounds.

5. How did your group end up at the end of the year (+ or -)? (include money received for extra allowances sold, money paid in penalties or for extra allowances needed, money paid for pollution reduction technology, and the number of allowances banked).
Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____
6. What is the current price of an allowance?
Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

Now go on to the next round. Your teacher will tell you the number of allowances each group will receive. Remember that this number may go up or down. For each round, fill in the above worksheet, recording the results of each round of trading. Be sure to keep track of your current account: the amount (+ or -) that your group has earned or spent.

Teacher Supplement 5

Air Pollution Allowance Trading Game Group 5

You are a coal-burning electric power utility with a single power plant. You have received 10 pollution allowances for the first year. The number of allowances you will receive in future rounds is unknown. Based on your current projections, you will emit 7,000 tons of pollution annually in the coming 5 years.

1. Calculate your pollution emission allowance for the year.

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

2. Do you have any allowances for the year (is your annual pollution emission less than your total allowances in hand)?

a) NO, skip to question 3

b) YES, how many? (You may skip question 3)

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

3. Did you exceed your allowances (is your annual pollution emission greater than your total allowances in hand)?

a) YES, How many extra allowances do you need?

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

b) Calculate any penalties you will pay if you are not able to purchase extra allowances.

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

c) How much would you be able to pay for an allowance? Divide the penalty amount by the number of allowances you need.

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

The auctioneer (your teacher) will now tally the number of allowances available.

4. Before trading begins, would you like to purchase pollution control technology? If yes, how many units?

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

Recalculate your annual pollution emissions.

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

The auctioneer will now re-tally the number of allowances available. Now begin trading. Some groups have extra allowances that they may wish to sell, while others will be paying fines if they do not acquire extra allowances. Note that groups with extra allowances do not have to sell them if the selling price is not high enough. They can bank them for use or sale in later rounds.

5. How did your group end up at the end of the year (+ or -)? (include money received for extra allowances sold, money paid in penalties or for extra allowances needed, money paid for pollution reduction technology, and the number of allowances banked.

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

6. What is the current price of an allowance?

Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

Now go on to the next round. Your teacher will tell you the number of allowances each group will receive. Remember that this number may go up or down. For each round, fill in the above worksheet, recording the results of each round of trading. Be sure to keep track of your current account: the amount (+ or -) that your group has earned or spent.

Air Pollution Allowance Trading Game
Group 6

You are a coal-burning electric power utility with a single power plant. You have received 10 pollution allowances for the first year. The number of allowances you will receive in future rounds is unknown. Based on your current projections, you will emit 12,000 tons of pollution annually in the coming 5 years.

1. Calculate your pollution emission allowance for the year.
Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____
2. Do you have any allowances for the year (is your annual pollution emission less than your total allowances in hand)?
a) NO, skip to question 3
b) YES, how many? (You may skip question 3)
Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____
3. Did you exceed your allowances (is your annual pollution emission greater than your total allowances in hand)?
a) YES, How many extra allowances do you need?
Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____
b) Calculate any penalties you will pay if you are not able to purchase extra allowances.
Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____
c) How much would you be able to pay for an allowance? Divide the penalty amount by the number of allowances you need.
Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

The auctioneer (your teacher) will now tally the number of allowances available.

4. Before trading begins, would you like to purchase pollution control technology? If yes, how many units?
Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____
Recalculate your annual pollution emissions.
Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

The auctioneer will now re-tally the number of allowances available. Now begin trading. Some groups have extra allowances that they may wish to sell, while others will be paying fines if they do not acquire extra allowances. Note that groups with extra allowances do not have to sell them if the selling price is not high enough. They can bank them for use or sale in later rounds.

5. How did your group end up at the end of the year (+ or -)? (include money received for extra allowances sold, money paid in penalties or for extra allowances needed, money paid for pollution reduction technology, and the number of allowances banked).
Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____
6. What is the current price of an allowance?
Year 1: _____ Year 2: _____ Year 3: _____ Year 4: _____ Year 5: _____

Now go on to the next round. Your teacher will tell you the number of allowances each group will receive. Remember that this number may go up or down. For each round, fill in the above worksheet, recording the results of each round of trading. Be sure to keep track of your current account: the amount (+ or -) that your group has earned or spent.

Written Test

Name _____

Date _____ Score _____

Objective 1

Match terms related to air resource management with their definitions. Write the corresponding numbers on the blanks provided.

- | | | |
|--------------------------|-------------------------------|--------------|
| 1. Air | 4. Ambient air | 7. Pollutant |
| 2. Air quality | 5. Atmosphere | 8. Pollution |
| 3. Air quality standards | 6. Point source air pollution | 9. Weather |

- _____ a. The mass of air surrounding the earth held by the force of gravity
- _____ b. A mixture of invisible, odorless, tasteless gases that surround the earth
- _____ c. Any introduced gas, liquid, or solid that makes a resource unfit for a specific purpose
- _____ d. The presence of matter or energy whose nature, location, or quantity produces undesirable environmental effects
- _____ e. The suitability of the air for use by living organisms
- _____ f. The air or atmosphere outside
- _____ g. The maximum level of atmospheric pollution allowed at one time in a geographical area
- _____ h. A specific place where air pollution originates
- _____ i. The current condition of the atmosphere including temperature, wind, moisture, and atmospheric pressure

Written Test

Objective 2

Select from a list the composition and percentages of air components (unpolluted). Place an "X" in the blanks next to the true statements.

- ☐ a. Oxygen 21%
- ☐ b. Hydrogen 25%
- ☐ c. Nitrogen 78%
- ☐ d. Zinc 2%
- ☐ e. Trace gases 1%

Objective 3

Select true statements concerning the importance of air quality by placing an "X" in the blanks next to the true statements.

- ☐ a. Air with high quality contains hazardous materials.
- ☐ b. Air with low quality is free from pollution.
- ☐ c. The EPA has air quality standards for the maximum amount of pollution that can be in ambient air.
- ☐ d. The quality of inside air is related to what is released into it.

Objective 4

Match air pollutants with their characteristics and health hazards. Write the corresponding numbers on the blanks provided.

- | | |
|----------------------------|--|
| 1. Particulate matter | 4. Sulfur dioxide (SO ₂) |
| 2. Ozone (O ₃) | 5. Nitrogen dioxide (NO ₂) |
| 3. Carbon monoxide (CO) | 6. Lead (Pb) (Airborne) |

- ☐ a. A heavy, pungent, colorless gas formed primarily through the burning of coal, fuel oils, and wood
- ☐ b. Finely divided solid or liquid particles in the air or in an emission such as dust, smoke, and fumes.
- ☐ c. Impairs ability of blood to carry oxygen; affects heart, lungs, and nervous system
- ☐ d. An invisible gas produced when oxygen in the air combines with nitric oxide that is produced by fossil fuel combustion, primarily in motor vehicles
- ☐ e. Serious respiratory problems such as breathing difficulties, asthma, reduced lung function, eye irritation, nasal congestion, and reduced resistance to infection
- ☐ f. Causes brain damage and serious physical and mental impairment, especially in children

Objective 5

Complete statements concerning the environmental effects of air pollution. Write the correct number on the blank provided before each item.

- _____ a. The greenhouse effect _____
- 1) Is caused by the depletion of the ozone shield
 - 2) Is caused by smog
 - 3) Is caused by carbon dioxide trapping heat
 - 4) Does not occur in winter
- _____ b. Global warming _____
- 1) Would benefit everyone
 - 2) Would cause sea levels to decrease due to evaporation
 - 3) Would not affect the natural ecosystem
 - 4) Would cause many agricultural areas to become nonproductive
- _____ c. The greenhouse effect is caused by _____
- 1) Natural decay of all vegetation
 - 2) Burning of fossil fuels
 - 3) Burning of rain forests
 - 4) All of the above
- _____ d. A solution to the problem of greenhouse effect is to _____
- 1) Cut down trees which produce carbon dioxide
 - 2) Burn more coal and oil
 - 3) Move to the country
 - 4) None of the above
- _____ e. Acid rain _____
- 1) Begins with the emission of sulfur dioxide and nitrogen dioxide
 - 2) Is caused by ozone in the atmosphere
 - 3) Is beneficial to streams and lakes
 - 4) Can be eliminated by reducing lead in the atmosphere
- _____ f. Acid rain _____
- 1) Increases fish populations
 - 2) Improves forests by killing pests
 - 3) Improves agricultural practices
 - 4) None of the above

Written Test

- _____ g. Acid rain can be reduced by _____
- 1) Burning less coal
 - 2) Reducing sulfur dioxide in automobile exhaust
 - 3) Converting to cleaner fuels such as natural gas, nuclear, solar or wind
 - 4) All of the above
- _____ h. Acid rain _____
- 1) Occurs only during the spring rains
 - 2) Leaches metals from the soils and affects fish and aquatic plants
 - 3) Is responsible for increased crop production
 - 4) Kills harmful insects
- _____ i. The ozone shield is a layer of ozone in the stratosphere _____
- 1) 6-30 miles above the earth
 - 2) 30-100 miles above the earth
 - 3) 1-2 miles above the earth
 - 4) None of the above
- _____ j. The depletion of the ozone shield is thought to be due to _____
- 1) Acid rain
 - 2) Attack by chlorofluorocarbons
 - 3) Increase in particulates in the atmosphere
 - 4) Global warming
- _____ k. If the ozone layer is destroyed, _____
- 1) Carbon dioxide levels would be reduced
 - 2) The price of ozone would increase
 - 3) Dangerous ultraviolet light will increase in intensity
 - 4) Another one could be built, but it would be expensive
- _____ l. Chlorofluorocarbons (CFCs) _____
- 1) Are carbon compounds which preserve ozone destruction
 - 2) Are manufactured and released to improve the air environment
 - 3) Are compounds consisting of chlorine, fluorine, and carbon
 - 4) Are good for the ozone layer

Written Test

_____ m. Reduction of the ozone layer _____

- 1) Will cause an increase in skin cancer
- 2) Will increase U.V. radiation striking the earth
- 3) Will decrease crop yields
- 4) All of the above

_____ n. Smog is generally found _____

- 1) In rural areas
- 2) Downwind of feed lots
- 3) In densely populated areas
- 4) In unpopulated areas

_____ o. Smog is caused by _____

- 1) Automobile exhaust
- 2) High winds
- 3) Chlorofluorocarbons
- 4) Sulfuric acid

Objective 6

Select true statements concerning indoor air pollution by placing an "X" in the blanks next to the true statements.

- _____ a. Indoor air quality is frequently worse than outdoor air.
- _____ b. Most people spend 90% of their time indoors.
- _____ c. New homes built to conserve energy usually do not have pollution problems.
- _____ d. Eye, ear, nose, and throat problems may be caused by indoor air pollution.
- _____ e. Indoor air pollution health problems are minor.

Written Test

Objective 7

Match indoor air pollutants with their characteristics. Write the corresponding numbers on the blanks provided.

- | | |
|--------------------------------|-----------------|
| 1. Asbestos | 4. Formaldehyde |
| 2. Biological pollutants | 5. Pesticides |
| 3. Environmental tobacco smoke | 6. Radon |

- _____ a. Found in furniture, foam insulation, and pressed wood products
- _____ b. Fibers are extremely small and become airborne when separated from parent material; can be inhaled or ingested; known to cause cancer
- _____ c. Include pollen, mold, fungi, and viruses which can be brought indoors through heating and air conditioning systems and then multiply inside
- _____ d. Contains heavy metals, particulates, and products of incomplete burning; causes from 50 to 5,000 deaths per year
- _____ e. Enters building through foundation cracks or seams; causes 5,000-20,000 deaths per year

Objective 8

Describe the Clean Air Act Amendments of 1990.

Objective 9

List four methods of controlling motor vehicle emissions.

- a. _____
- b. _____
- c. _____
- d. _____

Written Test

Objective 10	Match the types of pollution control measures that the government may impose on polluters to achieve compliance with environmental regulations with their descriptions. Write the corresponding numbers on the blanks provided. 1. Pollution allowances _____ a. Concentrate on the level of pollution in the local area requiring pollution reduction measures when the air is out of compliance. _____ b. Impose standards on the emissions coming from a facility without regard to the cost of achieving the standard or the mixture of that discharge with other point-source discharges in the local environment. 2. Point source air pollution controls
Objective 11	List three methods of controlling air pollution from industry and electrical power generating plants. a. _____ b. _____ c. _____
Objective 12	Select true statements on air quality trends in the United States by placing an "X" in the blanks next to the true statements. _____ a. Particulate levels have increased. _____ b. Carbon monoxide levels have increased. _____ c. Ozone levels have decreased. _____ d. Nitrogen dioxide levels have increased. _____ e. Lead in the atmosphere has decreased.
Objective 13	Discuss global considerations in air resource management. _____ _____ _____ _____ _____

Written Test

Objective 14

List the factors that cause weather.

- a. _____
- b. _____
- c. _____
- d. _____

Objective 15

List three career opportunities in air resource management.

- a. _____
- b. _____
- c. _____

*Permission to duplicate this test is granted.

Written Test—Answer Key

Objective 1

Match terms related to air resource management with their definitions. Write the corresponding numbers on the blanks provided.

- | | | |
|--------------------------|-------------------------------|--------------|
| 1. Air | 4. Ambient air | 7. Pollutant |
| 2. Air quality | 5. Atmosphere | 8. Pollution |
| 3. Air quality standards | 6. Point source air pollution | 9. Weather |

- 5 a. The mass of air surrounding the earth held by the force of gravity
- 1 b. A mixture of invisible, odorless, tasteless gases that surround the earth
- 7 c. Any introduced gas, liquid, or solid that makes a resource unfit for a specific purpose
- 8 d. The presence of matter or energy whose nature, location, or quantity produces undesirable environmental effects
- 2 e. The suitability of the air for use by living organisms
- 4 f. The air or atmosphere outside
- 3 g. The maximum level of atmospheric pollution allowed at one time in a geographical area
- 6 h. A specific place where air pollution originates
- 9 i. The current condition of the atmosphere including temperature, wind, moisture, and atmospheric pressure

Written Test—Answer Key

Objective 2

Select from a list the composition and percentages of air components (unpolluted). Place an "X" in the blanks next to the true statements.

- ☒ a. Oxygen 21%
- ☐ b. Hydrogen 25%
- ☒ c. Nitrogen 78%
- ☐ d. Zinc 2%
- ☒ e. Trace gases 1%

Objective 3

Select true statements concerning the importance of air quality by placing an "X" in the blanks next to the true statements.

- ☐ a. Air with high quality contains hazardous materials.
- ☐ b. Air with low quality is free from pollution.
- ☒ c. The EPA has air quality standards for the maximum amount of pollution that can be in ambient air.
- ☒ d. The quality of inside air is related to what is released into it.

Objective 4

Match air pollutants with their characteristics and health hazards. Write the corresponding numbers on the blanks provided.

- | | |
|----------------------------|--|
| 1. Particulate matter | 4. Sulfur dioxide (SO ₂) |
| 2. Ozone (O ₃) | 5. Nitrogen dioxide (NO ₂) |
| 3. Carbon monoxide (CO) | 6. Lead (Pb) (Airborne) |

- 4 a. A heavy, pungent, colorless gas formed primarily through the burning of coal, fuel oils, and wood
- 1 b. Finely divided solid or liquid particles in the air or in an emission such as dust, smoke, and fumes.
- 3 c. Impairs ability of blood to carry oxygen; affects heart, lungs, and nervous system
- 5 d. An invisible gas produced when oxygen in the air combines with nitric oxide that is produced by fossil fuel combustion, primarily in motor vehicles
- 2 e. Serious respiratory problems such as breathing difficulties, asthma, reduced lung function, eye irritation, nasal congestion, and reduced resistance to infection
- 6 f. Causes brain damage and serious physical and mental impairment, especially in children

Written Test—Answer Key

Objective 5

Complete statements concerning the environmental effects of air pollution. Write the correct number on the blank provided before each item.

- 3 a. The greenhouse effect _____
- 1) Is caused by the depletion of the ozone shield
 - 2) Is caused by smog
 - 3) Is caused by carbon dioxide trapping heat
 - 4) Does not occur in winter
- 4 b. Global warming _____
- 1) Would benefit everyone
 - 2) Would cause sea levels to decrease due to evaporation
 - 3) Would not affect the natural ecosystem
 - 4) Would cause many agricultural areas to become nonproductive
- 4 c. The greenhouse effect is caused by _____
- 1) Natural decay of all vegetation
 - 2) Burning of fossil fuels
 - 3) Burning of rain forests
 - 4) All of the above
- 4 d. A solution to the problem of greenhouse effect is to _____
- 1) Cut down trees which produce carbon dioxide
 - 2) Burn more coal and oil
 - 3) Move to the country
 - 4) None of the above
- 1 e. Acid rain _____
- 1) Begins with the emission of sulfur dioxide and nitrogen dioxide
 - 2) Is caused by ozone in the atmosphere
 - 3) Is beneficial to streams and lakes
 - 4) Can be eliminated by reducing lead in the atmosphere
- 4 f. Acid rain _____
- 1) Increases fish populations
 - 2) Improves forests by killing pests
 - 3) Improves agricultural practices
 - 4) None of the above

Written Test—Answer Key

- 4 g. Acid rain can be reduced by _____
- 1) Burning less coal
 - 2) Reducing sulfur dioxide in automobile exhaust
 - 3) Converting to cleaner fuels such as natural gas, nuclear, solar or wind
 - 4) All of the above
- 2 h. Acid rain _____
- 1) Occurs only during the spring rains
 - 2) Leaches metals from the soils and affects fish and aquatic plants
 - 3) Is responsible for increased crop production
 - 4) Kills harmful insects
- 1 i. The ozone shield is a layer of ozone in the stratosphere _____
- 1) 6-30 miles above the earth
 - 2) 30-100 miles above the earth
 - 3) 1-2 miles above the earth
 - 4) None of the above
- 2 j. The depletion of the ozone shield is thought to be due to _____
- 1) Acid rain
 - 2) Attack by chlorofluorocarbons
 - 3) Increase in particulates in the atmosphere
 - 4) Global warming
- 3 k. If the ozone layer is destroyed, _____
- 1) Carbon dioxide levels would be reduced
 - 2) The price of ozone would increase
 - 3) Dangerous ultraviolet light will increase in intensity
 - 4) Another one could be built, but it would be expensive
- 3 l. Chlorofluorocarbons (CFCs) _____
- 1) Are carbon compounds which preserve ozone destruction
 - 2) Are manufactured and released to improve the air environment
 - 3) Are compounds consisting of chlorine, fluorine, and carbon
 - 4) Are good for the ozone layer

Written Test—Answer Key

4 m. Reduction of the ozone layer _____

- 1) Will cause an increase in skin cancer
- 2) Will increase U.V. radiation striking the earth
- 3) Will decrease crop yields
- 4) All of the above

3 n. Smog is generally found _____

- 1) In rural areas
- 2) Downwind of feed lots
- 3) In densely populated areas
- 4) In unpopulated areas

1 o. Smog is caused by _____

- 1) Automobile exhaust
- 2) High winds
- 3) Chlorofluorocarbons
- 4) Sulfuric acid

Objective 6

Select true statements concerning indoor air pollution by placing an "X" in the blanks next to the true statements.

X a. Indoor air quality is frequently worse than outdoor air.

X b. Most people spend 90% of their time indoors.

_____ c. New homes built to conserve energy usually do not have pollution problems.

X d. Eye, ear, nose, and throat problems may be caused by indoor air pollution.

_____ e. Indoor air pollution health problems are minor.

Written Test—Answer Key

Objective 7

Match indoor air pollutants with their characteristics. Write the corresponding numbers on the blanks provided.

- | | |
|--------------------------------|-----------------|
| 1. Asbestos | 4. Formaldehyde |
| 2. Biological pollutants | 5. Pesticides |
| 3. Environmental tobacco smoke | 6. Radon |

- 4 a. Found in furniture, foam insulation, and pressed wood products
- 1 b. Fibers are extremely small and become airborne when separated from parent material; can be inhaled or ingested; known to cause cancer
- 2 c. Include pollen, mold, fungi, and viruses which can be brought indoors through heating and air conditioning systems and then multiply inside
- 3 d. Contains heavy metals, particulates, and products of incomplete burning; causes from 50 to 5,000 deaths per year
- 6 e. Enters building through foundation cracks or seams; causes 5,000-20,000 deaths per year

Objective 8

Describe the Clean Air Act Amendments of 1990.

In student's own words.

The Clean Air Act Amendments brought significant and wide-ranging changes dealing with all kinds of air pollution. Large or small, mobile or stationary sources were targeted. Routine and toxic emissions, ranging from power plants to consumer products were affected.

Objective 9

List four methods of controlling motor vehicle emissions.

Any four of the following:

- Reduce the escape of hydrocarbons from the fuel system.
- Keep engines tuned.
- Maintain emission control systems and catalytic converters.
- Use lead-free gasoline.
- Reduce sulfur compounds during refining of diesel fuel.
- Use ethanol (grain alcohol) as a fuel.
- Use methanol (wood alcohol) as a fuel.

Written Test—Answer Key

Objective 10

Match the types of pollution control measures that the government may impose on polluters to achieve compliance with environmental regulations with their descriptions. Write the corresponding numbers on the blanks provided.

- | | |
|-------------------------|--|
| 1. Pollution allowances | 2. Point source air pollution controls |
|-------------------------|--|

- 1 a. Concentrates on the level of pollution in the local area requiring pollution reduction measures when the air is out of compliance.
- 2 b. Impose standards on the emissions coming from a facility without regard to the cost of achieving the standard or the mixture of that discharge with other point-source discharges in the local environment.

Objective 11

List three methods of controlling air pollution from industry and electrical power generating plants.

Any three of the following:

- Install equipment (scrubbers) to remove air contaminants from stack exhaust.
- Remove pollutants from fuel source such as sulfur from coal.
- Use technologies with reduce contaminants in exhaust emissions.
- Use coal with low sulfur content.
- Convert operations to fuels which produce less air pollutants such as natural gas, solar, wind, and nuclear.

Objective 12

Select true statements on air quality trends in the United States by placing an "X" in the blanks next to the true statements.

- a. Particulate levels have increased.
- b. Carbon monoxide levels have increased.
- X c. Ozone levels have decreased.
- X d. Nitrogen dioxide levels have increased.
- X e. Lead in the atmosphere has decreased.

Objective 13

Discuss global considerations in air resource management.

Discussion should include that air pollution affects all countries. Pollutants generated in one country will cause problems in another country and worldwide. International cooperation is needed to control air pollution. Students may give specific examples.

Written Test—Answer Key

Objective 14

List the factors that cause weather.

In any order

- Air Measures and fronts
- Clouds and moisture
- Precipitation and humidity
- Wind

Objective 15

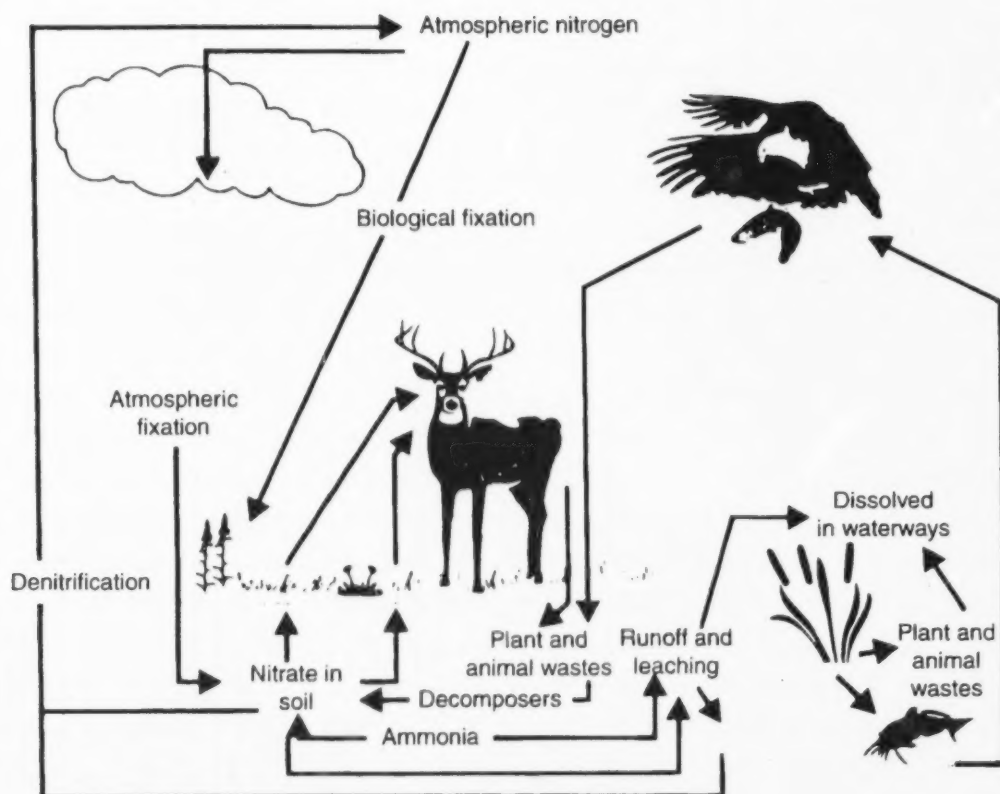
List three career opportunities in air resource management.

Any three of the following:

- Meteorology
- Environmental science
- Air quality management
- Physics
- Air quality engineering
- Physical, chemical, and engineering technicians

*Permission to duplicate this test is granted.

The Nitrogen Cycle



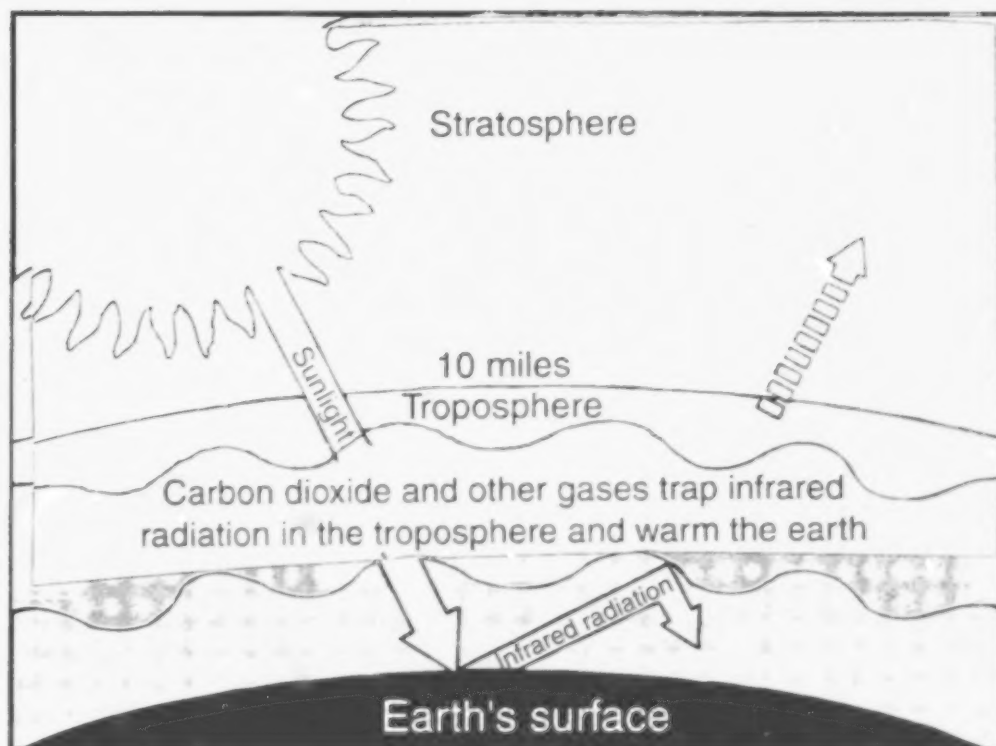
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Air Pollutants

Criteria Pollutant	Health Concerns
Ozone	Respiratory tract problems such as difficulty breathing and reduced lung function. Asthma, eye irritation, nasal congestion, reduced resistance to infection, and possibility premature aging of lung tissue.
Particulate Matter	Eye and throat irritation, bronchitis, lung damage, and impaired visibility
Carbon Monoxide	Ability of blood to carry oxygen impaired. Cardiovascular, nervous, and pulmonary systems affected
Sulfur Dioxide	Respiratory tract problems; permanent harm to lung tissue
Lead	Retardation and brain damage, especially in children
Nitrogen Dioxide	Respiratory illness and lung damage

Hazardous Air Pollutants	Health Concerns (no level is safe)
Asbestos	A variety of lung diseases, particularly lung cancer
Beryllium	Primarily lung disease, although also affects liver, spleen, kidneys, and lymph glands
Mercury	Several areas of the brain as well as the kidneys and bowels affected
Vinyl Chloride	Lung and liver cancer
Arsenic	Causes cancer
Radionuclides	Causes cancer
Benzene	Leukemia
Coke Oven Emissions	Respiratory cancer

Greenhouse Effect

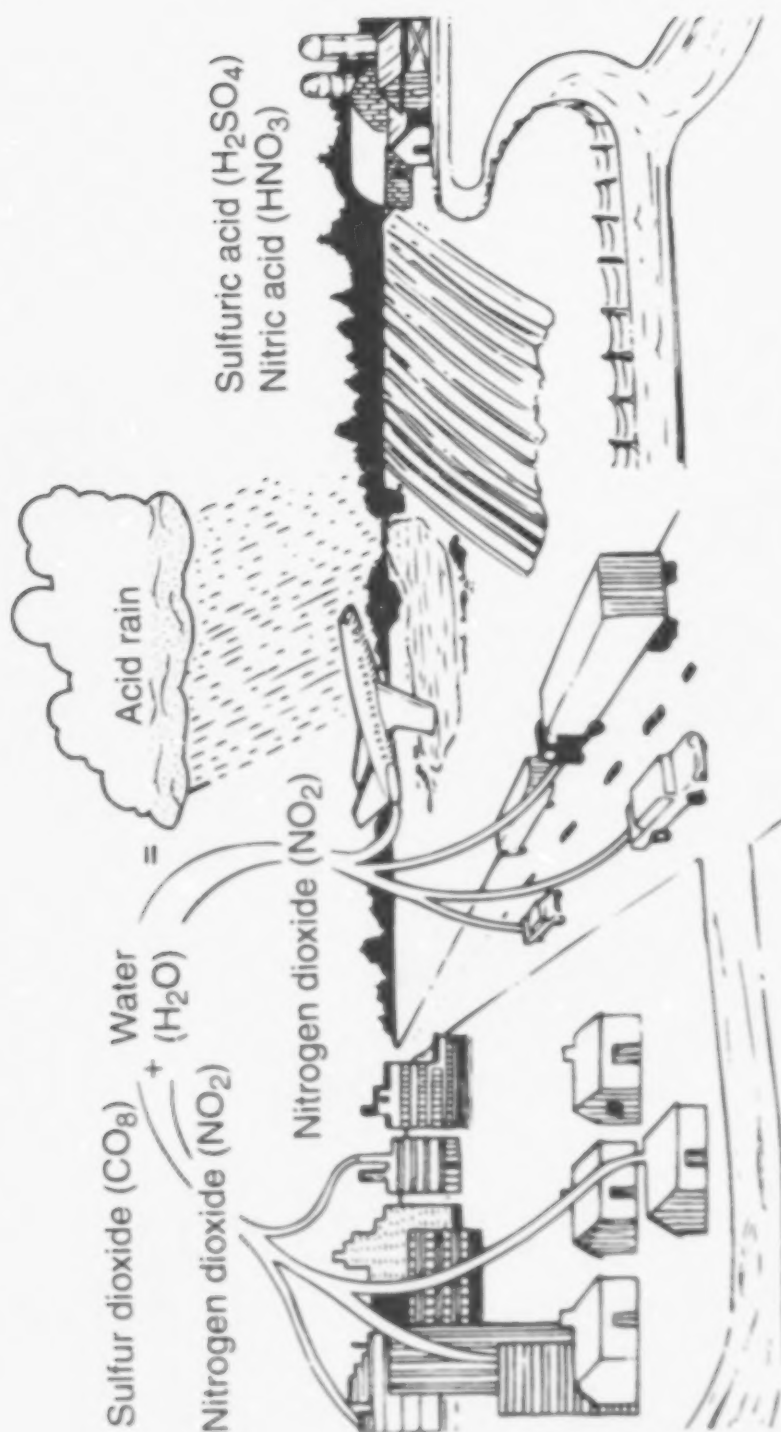


The Greenhouse Effect Traps Solar Heat

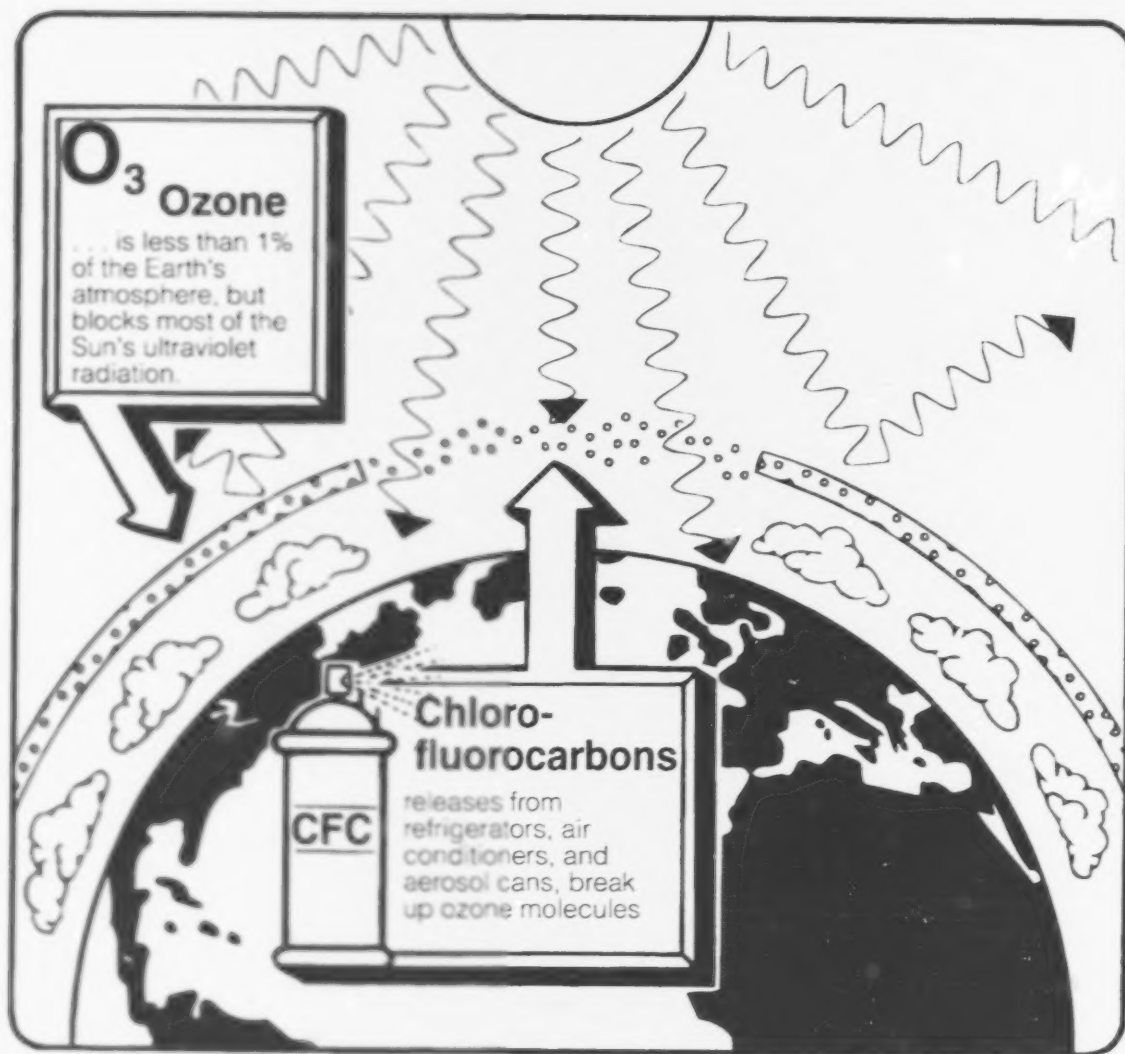
Courtesy of U.S. Environmental Protection Agency

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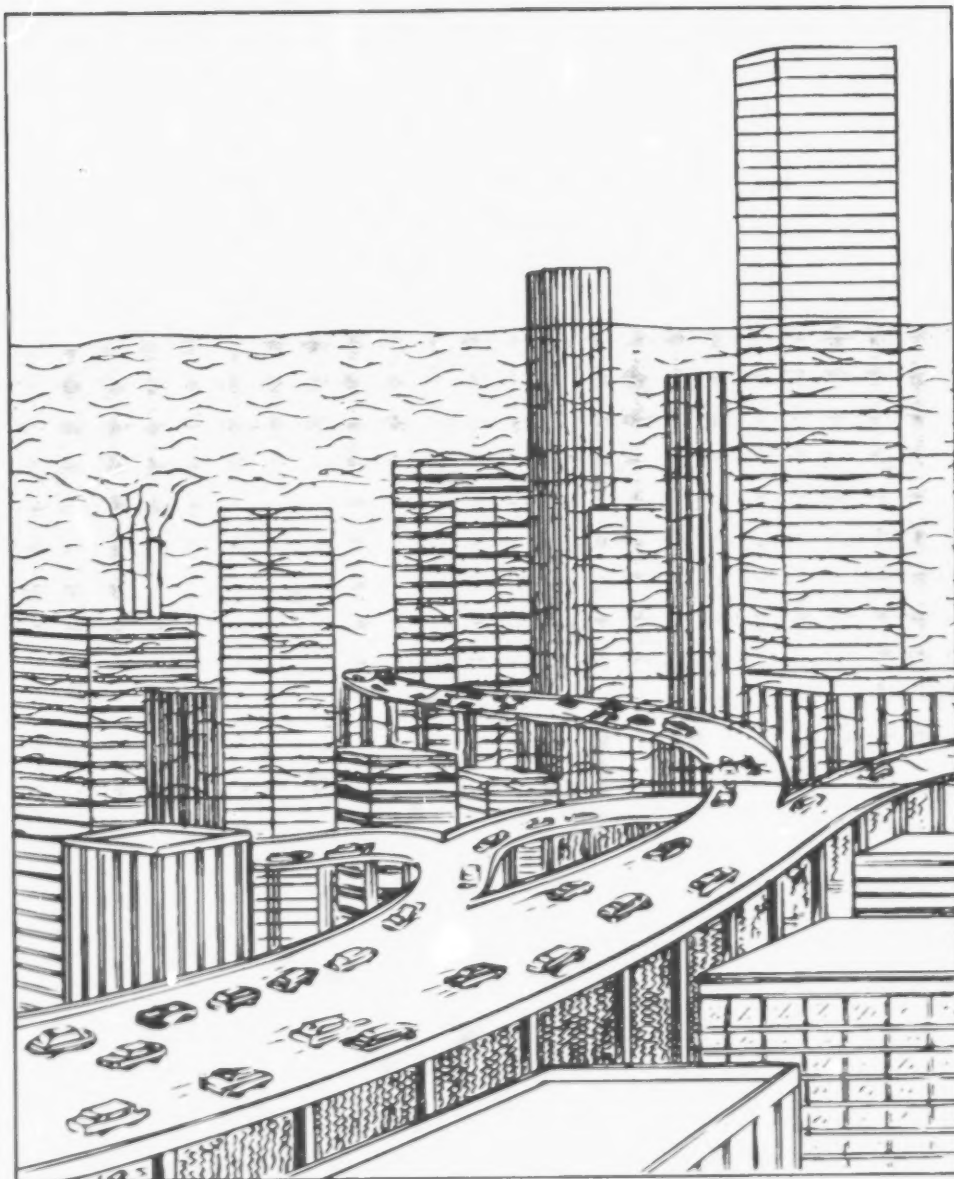
Acid Rain



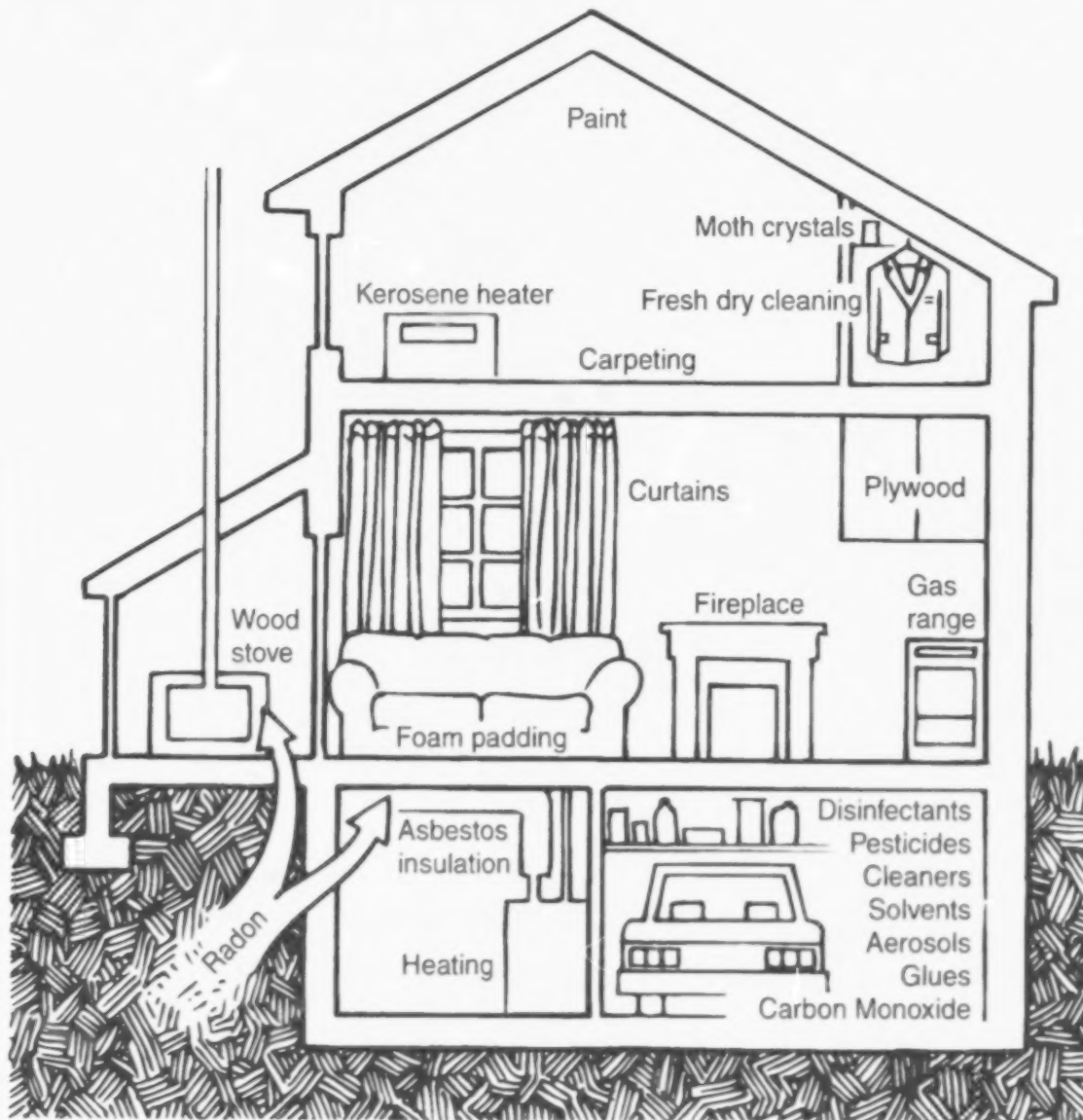
Ozone Shield



Smog



Indoor Air Pollution



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Unit 6

Energy Resources

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	* Assignment Sheets are located in the Student Workbook.

Suggested Activities**Instructional
Plan****Preparation**

- Review objective sheet. Study the specific objectives to determine the order in which you will present the objectives.
- Review the suggested lesson plan. The plan identifies an order for instruction to take place. Each "day" represents a 50-minute class period. The plan is designed to cover the specific objectives over a 15-day period. Additional days and/or activities may be added. (Note: You may want to change days to specific dates. Example: Day 1 may become Monday, January 25, Day 2 = Tuesday, January 26, and so forth.) You will want to localize, supplement, and personalize the plan to fit your situation.
- Review the teaching suggestions included in this instructional plan section to plan classroom activities. Also note the suggestions for supplemental resources.
- Plan your delivery/application to take advantage of student learning styles and to accommodate special-needs students.
- Obtain films, videotapes, and other media to supplement instruction of this unit. See "Resources Used in Developing This Unit" and "Suggested Supplemental Resources" for more information.
- Make transparencies or computer presentation from the transparency masters included in this unit. These appear in the teacher edition only and should be used with objectives as indicated below.

TM 1—Nonrenewable Energy Resources (Objective 3)

TM 2—Renewable Energy Resources (Objective 3)

TM 3—Oil and Gas Production (Objectives 5)

TM 4—Nuclear Energy Production (Objective 7)

TM 5—Hydropower Production (Objective 8)

TM 6—Biomass Conversion (Objective 9)

TM 7—Solar Collector Panel (Objective 10)

TM 8—Geothermal Reservoir (Objective 12)

Suggested Activities

- Use the following teacher supplements to enhance your delivery and application:
TS 1—Anaerobic Decay and Methane (Objective 9)
TS 2—Build and Operate a Methane Generator (Objective 9)
TS 3—Ideas for a Simple Solar Collector (Objective 10)
TS 4—Build and Test a Solar Collector (Objective 10)

Note: The teacher supplements may be used for teacher demonstration or as a student-centered activity.

- Select teacher components (written test, unit review, teacher supplements) you want to distribute to your students. Copy and prepare these components for distribution.
- Prepare classroom. Put up posters and charts and display articles and other references related to the objectives of this unit.

Delivery and Application

- Discuss unit and specific objectives.
- Discuss information sheets. Implement teaching plan to localize, supplement, and personalize the unit. Reinforce basic academic and workplace skills when applicable.
- Discuss the assignment sheets. Review with students the criteria for evaluation of each of these activities.

Teaching Suggestions

The skill areas appearing in bold-face type in the teaching suggestions refer to the academic and workplace skills identified in *What Work Requires of Schools: A SCANS Report for America 2000* and *Workplace Basics: The Skills Employers Want*. These have been adapted by MAVCC.

- Arrange for representatives of the power generation industry—preferably those representing firms using several types of fuel to explain the process for making electricity. Also, you may wish to have representatives of the oil and natural gas industries visit with the class to explain how these products are extracted, refined, and transported to end users. (**Listening; acquiring scientific information**)
- Plan a field trip to an electrical generation plant. Have students prepare questions to ask about how electricity is generated and distributed to the customers. (**Listening; acquiring scientific information**)

Suggested Activities

- Following the completion of Assignment Sheet 2, organize a class debate on generation of electricity from coal vs. nuclear power. **(Comprehending written information and analyzing and applying what has been read to a specific task; speaking; critical thinking)**
- Invite a local utility representative to discuss energy audits his or her firm conducts, then have class members complete energy audits at home using Assignment Sheet 4 in this unit. **(Listening; critical thinking; comprehending written information and analyzing data)**
- Organize the class into teams to build a methane generator or a simple solar collector. (Teacher Supplements 2, 3 and 4)

Evaluation

- Give and evaluate Energy Resources Review.
- Copy written test and give to students as pretest.
- Evaluate assignment sheets. See the evaluation criteria listed at the top of each assignment sheet. Evaluation may be localized, personalized, or individualized to fit your situation. Record student's grade in your grade book.
- Give and evaluate written test. Record student's written test score in your grade book and on the student's competency profile.
- Measure competency gains by comparing written pretest scores with posttest scores.
- Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas of improvement.
- Reteach and retest as required.

Instructions for Evaluating Student Performance

- When the student is ready to perform a specific task, obtain a copy of the assignment sheet which may be found in the student workbook.
- Once the student has completed an assignment sheet, evaluate the student's work using the evaluation criteria. If the student's work is unsatisfactory, have the student review the assignment sheet and submit their work for evaluation again. Record the appropriate level of competency on the student's competency profile.

Suggested Activities

	- Sample performance evaluation keys have been provided below. Many other keys are available. Select one rating (grading scale) which best fits your program needs. Sample A 4—Skilled—Can perform job with no additional training. 3—Moderately skilled—Has performed job during training program; limited additional training may be required. 2—Limited skill—Has performed job during training program; additional training is required to develop skill. 1—Unskilled—Is familiar with process, but is unable to perform job. 0—No exposure—No information or practice provided during training program. Sample B Yes—Can perform job with no additional training. No—Is unable to perform job satisfactorily. - Encourage students to continue their portfolio. The portfolio should become a record of the student's progress in the study of natural resources.
Resources Used in Developing This Unit	Note: URLs change frequently. Any of the web sites listed may have moved. - Porter, Lynn, Jasper S. Lee, Diana L. Turner, and Malcolm Hillan, <i>Environmental Science and Technology (2nd Edition)</i>, Danville, IL, Interstate Publishers, Inc., 2003. www.interstatepublishers.com - Lee, Jasper S., <i>Natural Resources and Environmental Technology</i>, Danville, IL, Interstate Publishers, Inc., 2000. www.interstatepublishers.com - Camp, William G. and Thomas B. Daugherty, <i>Managing Our Natural Resources (4th Edition)</i>, Albany, NY, Delmar, 2002. www.agriscience.com <i>Nuclear Electricity and Energy Independence</i>. U.S. Council for Energy Awareness, P.O. Box 66080, Dept. C104. Washington, D.C. 20035.
Suggested Supplemental Resources	American Petroleum Institute 1220 L. Street, NW Washington, D.C. 20005 Phone: 202-682-8000 www.api.org API is the primary trade association for the oil and natural gas industry. Site includes: policy issues, about oil and natural gas, environmental commitment, industry statistics, focus on innovation, in the classroom, media center, and links and resources.

Suggested Activities

In the classroom (www.classroom-energy.org) has activities for teachers and students including a free "Classroom Energy" CD. Site includes: background information, classroom activities, lesson plans, interactive tours, and links to a variety of energy education resources.

- National Science Teachers Association — The Science of Energy
www.nsta.org/enerav

Site includes: Find It Here (library of energy resources), You Decide (interactive simulation), and Did You Know (energy facts and figures).

- Jefferson Lab (Jlab)
1200 Jefferson Ave., MS16C
Newport News, VA 23606
Phone: 757-269-7560
www.jlab.org

Jlab is managed and operated by Southeastern University Research Association (SURA) for the U.S. Department of Energy (DOE). Science education site includes: teacher resources, student zone, games and puzzles, and programs and events. Resources include hands-on activities, worksheets, puzzles and games, and on-line games and puzzles.

- National Energy Foundation
3676 California Ave. Suite A117
Salt Lake City, UT 84104
Phone: 801-908-5400
www.nef1.org

Non-profit organization providing resources for education. Has numerous teacher and student links for energy education.

- U.S. Department of Energy (DOE)
www.energy.gov

DOE contributes to the future of the nation by ensuring our energy security, maintaining the safety and reliability of our nuclear stockpile, cleaning up the environment from the legacy of the Cold War, and developing innovations in science and technology.

Suggested Activities

- U.S. Department of Energy Office of Environmental Management (EM)
P.O. Box 23769
Washington, D.C. 20026
Phone: 800-7EM-DATA
www.em.doe.gov

Responsible for management of nuclear environment. Site for "Selected Resources" (www.em.doe.gov/timeline/resource.html) has information on: History of Nuclear Age, Nuclear Energy (Grades K-6, Grades 7-12, and General), Nuclear Waste Management and Clean-Up (Grades 7-12 and General), Radiation (Grades 7-12), and Teacher's Guides.

- U.S. Department of Energy Office of Energy Efficiency and Renewable Energy (EERE)
www.eren.doe.gov

EERE is gateway to hundreds of web sites and thousands of online documents on energy efficiency and renewable energy. Renewable energy information on bioenergy, geothermal, hydrogen, hydropower, ocean, solar, wind.

Energy Savers — Tips on Saving Energy and Money at Home
www.eren.doe.gov/consumerinfo/energy_save

Consumer energy information for your home, business/work, school and transportation. www.eren.doe.gov/consumerinfo

- The Environmental Literacy Council
www.enviroliteracy.org

The Council is a non-profit organization that provides tools and resources to teachers to help students develop environmental literacy. The site provides links to various environmental sites.

- CONNECTicut Energy Council for Teachers
980 Old Colony Road
Meriden, CT 06451
www.connectenergyed.com/home

CONNECT is a non-profit organization established in 1979 to provide energy education information to teachers and student from grades K through college. Programs and services are developed so that energy information is available to and appropriate for both science and non-science teachers and students. Workshops and activities focus on a hands-on approach to learning, and are cross-disciplinary in their application.

Suggested Lesson Plan

Day 1

Introduction:

- Discuss unit objective and review specific objectives and plan for completing this unit.
- Have students read the introduction.
- Discuss energy resources.
 - What is energy?
 - Why are fossil fuels being consumed more rapidly than they are being produced?
 - What are several reasons to use renewable energy?
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 2—Terms used to describe energy conservation.
- Discuss Objective 3—Classifications of energy resources.
- Use TM 1 to illustrate nonrenewable energy resources.
- Use TM 2 to illustrate renewable energy resources.
- Discuss Objective 4—Coal energy resources.

Closure:

- Review discussion on introductory remarks.
- Review Objectives 2 and 3.

Evaluation:

- Non-applicable.

Day 2

Introduction:

- Review Objective 4.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 5—Oil energy resources.
- Use TM 3 to illustrate oil and gas production.
- Discuss Objective 6—Natural gas energy resources.
- Assign Assignment Sheet 1—Discuss the Effects of Our Dependence on Imported Oil
 - Lead class discussion on effects our dependence on imported oil has on the citizens of the U.S. and on our national economy. Use Objective 5, 13, and 14 for information. Also, web site for American Petroleum Institute (www.api.com)
 - Make sure students list the information on a sheet of paper.
 - Allow time for students to research other sources.
 - Complete Assignment Sheet 1 during next class period.

Closure:

- Review Objectives 5 and 6.

Suggested Lesson Plan

Day 3

Evaluation:

- Non-applicable.

Introduction:

- Review previous class discussion on Assignment 1.
- State the objectives for today's lesson.

Delivery and Application:

- Complete Assignment Sheet 1.
 - Have students complete list on "the effects on you personally".
 - Have students discuss their lists in class.
- Turn in Assignment Sheet 1.
- Discuss Objective 7—Nuclear energy resources.
- Use TM 4 to illustrate nuclear energy production.

Closure:

- Review Objective 7.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 1 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 1 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Day 4

Introduction:

- Return Assignment Sheet 1. Discuss, if necessary.
- State the objectives for today's lesson.

Delivery and Application:

- Assign Assignment Sheet 2—Compare Electricity Production From Coal and Nuclear Fuels.
 - Read introduction and directions.
 - Review Objectives 4, 7, and 13.
 - Provide supervised study for students to research and complete the assignment sheet.
 - Due during next class.

Closure:

- Review progress on Assignment Sheet 2.

Evaluation:

- Non-applicable.

Suggested Lesson Plan

Day 5

Introduction:

- Review progress on Assignment Sheet 2.
- State the objectives for today's lesson.

Delivery and Application:

- Provide supervised study to complete Assignment Sheet 2.
- Discuss results of Assignment Sheet 2.
 - Positive and negative aspects.
 - Personal concerns

Closure:

- Turn in Assignment Sheet 2.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 2 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 2 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Day 6

Introduction:

- Return Assignment Sheet 2. Discuss, if necessary.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 8—Hydropower energy resources.
- Use TM 5 to illustrate hydropower production.
- Discuss Objective 9—Biomass energy resources.
- Use TM 6 to illustrate biomass conversion.
- Discuss Objective 10—Solar energy resources.
- Use TM 7 to illustrate a solar collection panel.

Closure:

- Review Objective 8.

Evaluation:

- Non-applicable.

Day 7

Introduction:

- Review Objectives 9 and 10.
- State the objectives for today's lesson.

Suggested Lesson Plan

Day 8

Delivery and Application:

- Discuss Objective 11—Wind energy resources.
- Discuss Objective 12—Geothermal energy resources.
- Use TM 8 to illustrate a geothermal reservoir.
- Assign Assignment Sheet 3—Give Your Opinion on Using Agricultural Products as Alternative Energy Resources.
 - Read the introduction and directions.
 - Review Objective 9.
 - Due on Day 9.
 - Provide supervised study for research.

Closure:

- Review Objective 11.

Evaluation:

- Non-applicable.

Introduction:

- Review progress on Assignment 3.
- Review Objective 12.
- State the objectives for today's lesson.

Delivery and Application:

- Provide supervised study for completion of Assignment 3.

Closure:

- Remind students Assignment Sheet 3 is due at beginning of next class.

Evaluation:

- Non-applicable.

Day 9

Introduction:

- Review progress on Assignment Sheet 3.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss finding from Assignment Sheet 3.
- Turn in Assignment Sheet 3.
- Assign Assignment Sheet 4—Perform an Energy Audit of Your Home.
 - Read introduction and directions.
 - Review inspection form.
 - Due on Day 11.
- Discuss Objective 13—U.S. energy reserves.
- Discuss Objective 14—Use of oil resources in the U.S.

Closure:

- Remind students of due date of Assignment Sheet 4.

Suggested Lesson Plan

Day 10

Evaluation:

- Evaluate each student's performance on Assignment Sheet 3 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 3 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Introduction:

- Return Assignment Sheet 3. Discuss, if necessary.
- Review progress on Assignment Sheet 4.
- Review Objectives 13 and 14.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 15—Goals of energy conservation.
- Discuss Objective 16—Ways to conserve energy.
 - Relate way to conserve energy for residential audit on Assignment Sheet 4.
- Assign Assignment Sheet 5—Explore the Various Factions and Viewpoints Involved with the Use of Renewable and Nonrenewable Resources.
 - Read introduction and directions.
 - Review suggestions for reports.
 - Have each student select a topic for his or her report. Due date is Day 15.
- Allow supervised study for completion of Assignment Sheet 4 or research for Assignment Sheet 5.

Closure:

- Review Objective 15.
- Remind students that Assignment Sheet 4 is due at the next class.

Evaluation:

- Non-applicable.

Day 11

Introduction:

- Review progress on Assignment Sheet 4.
- Review Objective 16.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss findings for Assignment Sheet 4.
- Turn in Assignment Sheet 4.
- Discuss Objective 17—Career opportunities related to energy resources.
- Supervised study for research on Assignment Sheet 5.

Closure:

- Remind students that Assignment Sheet 5 is due on Day 15.
- Remind students that written test will be on Day 14.

Suggested Lesson Plan

Day 12

Evaluation:

- Evaluate each student's performance on Assignment Sheet 4 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 4 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Introduction:

- Review progress on Assignment Sheet 5.
- State the objectives for today's lesson.

Delivery and Application:

- Have students complete Energy Resources Review.
- Turn in Energy Resources Review.
- Provide supervised study for Assignment Sheet 5.

Closure:

- Remind students of Assignment Sheet 5 due date.
- Remind students of written test on Day 14.

Evaluation:

- Evaluate each student's performance on Energy Resource Review according to criteria stated on answer key.
- Record student's Energy Resource Review grade in grade book.

Day 13

Introduction:

- Review progress on Assignment Sheet 5.
- Return Energy Resource Review. Discuss, if necessary.
- State the objectives for today's lesson.

Delivery and Application:

- Provide supervised study for review for written test and/or completion of Assignment Sheet 5.

Closure:

- Remind students of Assignment Sheet 5 due date.
- Remind students of written test during next class.

Evaluation:

- Non-applicable

Day 14

Introduction:

- Review for written test.
- State the objectives for today's lesson

Delivery and Application:

- Give written test.
- Turn in written test.
- Have students who have completed the written test continue their work on Assignment Sheet 5.

Suggested Lesson Plan

Day 15

Closure:

- Review expectations for Assignment 5.

Evaluation:

- Evaluate each student's performance on written test using the answer key. (Note: Develop teaching strategies for students who did not achieve minimum criteria.)
- Record student's written test grade in grade book.
- Record written test score on each student's competency profile.

Introduction:

- Return written test and review answers.
- Discuss strategies for students who did not achieve the minimum criteria on written test.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss findings on Assignment Sheet 5.
- Turn in Assignment Sheet 5.

Closure:

- Review unit objectives.
- Review next lesson.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 5 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 5 grade in grade book.
- Record appropriate competency level on each student's competency profile.
- Return Assignment Sheet 5 at next class.

Energy Resources Review

Name _____ Overall Rating _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate serious effort was taken in completing worksheet	_____

Introduction

For many years, fossil fuels were believed to be our only source of energy. The United States has reserves of each, but we must remember that they are nonrenewable resources. Some day they will run out. We must constantly be on the lookout for advanced technology that will help us conserve these valuable and useful resources. These include improved discovery and recovery methods and better processing methods as well as consumer conservation measures. We need to continue to search for possible alternative sources of energy for use in our homes, our work, and for our transportation needs.

Directions

Answer the following questions concerning energy resources. For help, refer to the information sheets in this unit. Circle the correct response for each question.

1. _____ is defined as the capacity to do work or the ability to make things move.
 - a. Fossil fuels
 - b. Combustion
 - c. Energy
 - d. Biomass
2. Transformation of energy states that:
 - a. Energy of an object or body due to its motion; the ability to move an object a vertical distance.
 - b. Energy is constantly changing from potential energy to kinetic energy and back to potential.
 - c. Energy due to the place or position of something; it is not moving but could do so under the right conditions.
 - d. Energy is like driving a car off a mountain.
3. _____ is a nonrenewable resource.
 - a. Solar
 - b. Wind
 - c. Uranium
 - d. Biomass

Review

4. _____ is a fossil fuel.
 - a. Uranium
 - b. Oil
 - c. Geothermal
 - d. Hydropower
5. Coal is:
 - a. A dark brown to black, flammable, solid fossil fuel.
 - b. A natural, yellow-to-black, flammable, thick liquid fossil fuel.
 - c. Any plant derived organic matter available on a renewable basis.
 - d. A type of wood that has been heated to very high temperatures.
6. _____ is the chemical process of burning which releases heat, light, and chemical by-products.
 - a. Fossil fuel
 - b. Energy
 - c. Combustion
 - d. Biomass energy
7. An environmental consideration of coal use.
 - a. Producing and abandoned wells can pollute ground water.
 - b. Disposal of radioactive waste following use.
 - c. Use of coal will reduce the amount of pollutants produced by other fossil fuels.
 - d. Disposal of 10% of coal as ash following combustion.
8. Oil is produced by:
 - a. Strip-mining
 - b. Hard rock mining
 - c. Springs
 - d. Drilling a well to the resource formations.
9. The U.S. imports approximately _____ % of the oil it uses.
 - a. 25%
 - b. 75%
 - c. 50%
 - d. 33%
10. Butane and propane are derived from:
 - a. Oil
 - b. Natural gas
 - c. Coal
 - d. Biomass energy

11. Nuclear energy is produced from:
 - a. Coal
 - b. Uranium
 - c. Wind
 - d. Solar
12. An environmental problem associated with nuclear energy.
 - a. Rehabilitation of surface areas disturbed by strip mining.
 - b. Fear of a reactor accident, which would release radioactivity to the surrounding area.
 - c. Disposal of solar cells at the end of their useful life.
 - d. Uranium supplies are being depleted
13. _____ is the most economical source of electricity.
 - a. Solar energy
 - b. Hydropower
 - c. Geothermal
 - d. Nuclear energy
14. Biomass conversion or biogeneration uses _____ as sources of fuel.
 - a. Water and steam
 - b. Plant materials and animal waste
 - c. Oil and natural gas
 - d. Wind and the sun
15. Solar collectors are used to:
 - a. Store and transmit heat.
 - b. Cool commercial buildings.
 - c. Provide sun to tanning salons.
 - d. Run windmills.
16. Wind energy is energy developed by:
 - a. Solar collectors.
 - b. The movement of air.
 - c. Turbines.
 - d. Geothermal.
17. Geothermal energy is produced by:
 - a. Drilling wells to underground steam formations.
 - b. The force of moving water.
 - c. The movement of air.
 - d. Above ground springs.

Review

18. U.S. coal reserves represent _____ % of the world's total.
- a. 10%
 - b. 25%
 - c. 33%
 - d. 50%
19. Natural gas reserves will supply the U.S. for _____ years.
- a. 54
 - b. 300
 - c. 225
 - d. 75
20. The U.S. has only _____ % of the world's supply of oil.
- a. 25%
 - b. 4%
 - c. 50%
 - d. 66%
21. The U.S. has _____ % of the world's supply of uranium.
- a. 25%
 - b. 33%
 - c. 50%
 - d. 66%
22. Transportation accounts for _____ % of the oil resources used in the U.S.
- a. 37.8%
 - b. 14.6%
 - c. 20.7%
 - d. 26.9%
23. A goal of energy conservation.
- a. To increase spending for energy.
 - b. To reduce the amount of energy that must be produced to meet demands.
 - c. To increase our reliance on foreign energy for political and economic reasons.
 - d. To change the environment by increasing harmful emissions from energy use.

-
- 24. A way to conserve energy in a residence.
 - a. Increase hot water use.
 - b. Keep door and windows open.
 - c. Raise thermostat settings in winter.
 - d. Turn off lights when not needed.

 - 25. A way to conserve energy for transportation.
 - a. Increase speed on highways.
 - b. Always drive by yourself.
 - c. Decrease fuel-efficiency of engines.
 - d. Use public transportation.

 - 26. Planned management of energy resources, which conserves, protects, and prevents waste.
 - a. Energy reserves
 - b. Energy conservation
 - c. Renewable energy
 - d. Combustion

Energy Resources Review—Answer Key

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate serious effort was taken in completing worksheet	_____

Introduction

For many years, fossil fuels were believed to be our only source of energy. The United States has reserves of each, but we must remember that they are nonrenewable resources. Some day they will run out. We must constantly be on the lookout for advanced technology that will help us conserve these valuable and useful resources. These include improved discovery and recovery methods and better processing methods as well as consumer conservation measures. We need to continue to search for possible alternative sources of energy for use in our homes, our work, and for our transportation needs.

Directions

Answer the following questions concerning energy resources. For help, refer to the information sheets in this unit. Circle the correct response for each question.

1. _____ is defined as the capacity to do work or the ability to make things move.
 - a. Fossil fuels
 - b. Combustion
 - c. **Energy**
 - d. Biomass
2. Transformation of energy states that:
 - a. Energy of an object or body due to its motion; the ability to move an object a vertical distance.
 - b. **Energy is constantly changing from potential energy to kinetic energy and back to potential.**
 - c. Energy due to the place or position of something; it is not moving but could do so under the right conditions.
 - d. Energy is like driving a car off a mountain.
3. _____ is a nonrenewable resource.
 - a. Solar
 - b. Wind
 - c. **Uranium**
 - d. Biomass

Review—Answer Key

4. _____ is a fossil fuel.
- a. Uranium
 - b. Oil**
 - c. Geothermal
 - d. Hydropower
5. Coal is:
- a. A dark brown to black, flammable, solid fossil fuel.**
 - b. A natural, yellow-to-black, flammable, thick liquid fossil fuel.
 - c. Any plant derived organic matter available on a renewable basis.
 - d. A type of wood that has been heated to very high temperatures.
6. _____ is the chemical process of burning which releases heat, light, and chemical by-products.
- a. Fossil fuel
 - b. Energy
 - c. Combustion**
 - d. Biomass energy
7. An environmental consideration of coal use.
- a. Producing and abandoned wells can pollute ground water.
 - b. Disposal of radioactive waste following use.
 - c. Use of coal will reduce the amount of pollutants produced by other fossil fuels.
 - d. Disposal of 10% of coal as ash following combustion.**
8. Oil is produced by:
- a. Strip-mining
 - b. Hard rock mining
 - c. Springs
 - d. Drilling a well to the resource formations.**
9. The U.S. imports approximately _____ % of the oil it uses.
- a. 25%
 - b. 75%
 - c. 50%**
 - d. 33%
10. Butane and propane are derived from:
- a. Oil
 - b. Natural gas**
 - c. Coal
 - d. Biomass energy

Review—Answer Key

11. Nuclear energy is produced from:
 - a. Coal
 - b. Uranium**
 - c. Wind
 - d. Solar
12. An environmental problem associated with nuclear energy.
 - a. Rehabilitation of surface areas disturbed by strip mining.
 - b. Fear of a reactor accident, which would release radioactivity to the surrounding area.**
 - c. Disposal of solar cells at the end of their useful life.
 - d. Uranium supplies are being depleted
13. _____ is the most economical source of electricity.
 - a. Solar energy
 - b. Hydropower**
 - c. Geothermal
 - d. Nuclear energy
14. Biomass conversion or biogenesis uses _____ as sources of fuel.
 - a. Water and steam
 - b. Plant materials and animal waste**
 - c. Oil and natural gas
 - d. Wind and the sun
15. Solar collectors are used to:
 - a. Store and transmit heat.**
 - b. Cool commercial buildings.
 - c. Provide sun to tanning salons.
 - d. Run windmills.
16. Wind energy is energy developed by:
 - a. Solar collectors.
 - b. The movement of air.**
 - c. Turbines.
 - d. Geothermal.
17. Geothermal energy is produced by:
 - a. Drilling wells to underground steam formations.**
 - b. The force of moving water.
 - c. The movement of air.
 - d. Above ground springs.

Review—Answer Key

18. U.S. coal reserves represent _____% of the world's total.
- a. 10%
 - b. 25%**
 - c. 33%
 - d. 50%
19. Natural gas reserves will supply the U.S. for _____ years.
- a. 54**
 - b. 300
 - c. 225
 - d. 75
20. The U.S. has only _____% of the world's supply of oil.
- a. 25%
 - b. 4%**
 - c. 50%
 - d. 66%
21. The U.S. has _____% of the world's supply of uranium.
- a. 25%**
 - b. 33%
 - c. 50%
 - d. 66%
22. Transportation accounts for _____% of the oil resources used in the U.S.
- a. 37.8%
 - b. 14.6%
 - c. 20.7%
 - d. 26.9%**
23. A goal of energy conservation.
- a. To increase spending for energy.
 - b. To reduce the amount of energy that must be produced to meet demands.**
 - c. To increase our reliance on foreign energy for political and economic reasons.
 - d. To change the environment by increasing harmful emissions from energy use.

Review—Answer Key

24. A way to conserve energy in a residence.
- a. Increase hot water use.
 - b. Keep door and windows open.
 - c. Raise thermostat settings in winter.
 - d. Turn off lights when not needed.**
25. A way to conserve energy for transportation.
- a. Increase speed on highways.
 - b. Always drive by yourself.
 - c. Decrease fuel-efficiency of engines.
 - d. Use public transportation.**
26. Planned management of energy resources, which conserves, protects, and prevents waste.
- a. Energy reserves
 - b. Energy conservation**
 - c. Renewable energy
 - d. Combustion

Answers to Assignment Sheets**Assignment
Sheet 1****Discuss the Effects of Our Dependence on Imported Oil**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 2****Compare Electricity Production From Coal and Nuclear Fuel**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 3****Give Your Opinion on Using Agricultural Products as Alternative Energy Resources**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 4****Perform an Energy Audit of Your Home**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 5****Explore the Various Factions and Viewpoints Involved With the Use of Renewable and Nonrenewable Resources**

Student performance should be evaluated according to criteria listed on the assignment sheet.

Teacher Supplement 1—Anaerobic Decay and Methane Production

If you have ever experienced the "rotten egg" smell of rotting vegetation in the aftermath of a flood, you have witnessed one of the oldest processes of decomposition on earth. The smell that greeted you was traces of hydrogen sulfide produced as anaerobic bacteria (those that thrive without oxygen) consumed plant material and gave off CO_2 , methane (CH_4), water, and traces of hydrogen sulfide (H_2S)

Methane, of course is the basic compound found in "natural gas," a clean-burning, relatively nonpolluting fuel used for light, heat, internal combustion fuel, boiler fuel, and fertilizer production.

The oldest form of a methane "digester," is the flood pool you may have smelled. Organic matter covered by a pool of warm water will first turn acidic and smell rank, then slowly—over about six months—will turn alkaline. The methane bacteria (always present) will take over and decompose the organic matter in the pond, and gas bubbles will rise to the top.

Given tremendous amounts of animal and plant waste available, and given limited amounts of natural gas and other fossil fuels, the conversion of biomass to useful fuels and other organic solids is a potential asset in a world in need of additional fuel and fertilizer. Operated correctly a methane digester can produce biogas from animal wastes which contains about 70 percent methane.

In fact, the Los Angeles Hyperion sewage treatment plant recovers enough methane from its primary sewage treatment facility to power twenty-four 2,000 hp. diesel engines on site. Throughout the developing world small farm-size digesters produce gas for home heating, agricultural processing, lights, and tractor fuel. In the U.S., however, the potentials of biogas manufacture have scarcely been tapped because other forms of energy have been economically more attractive.

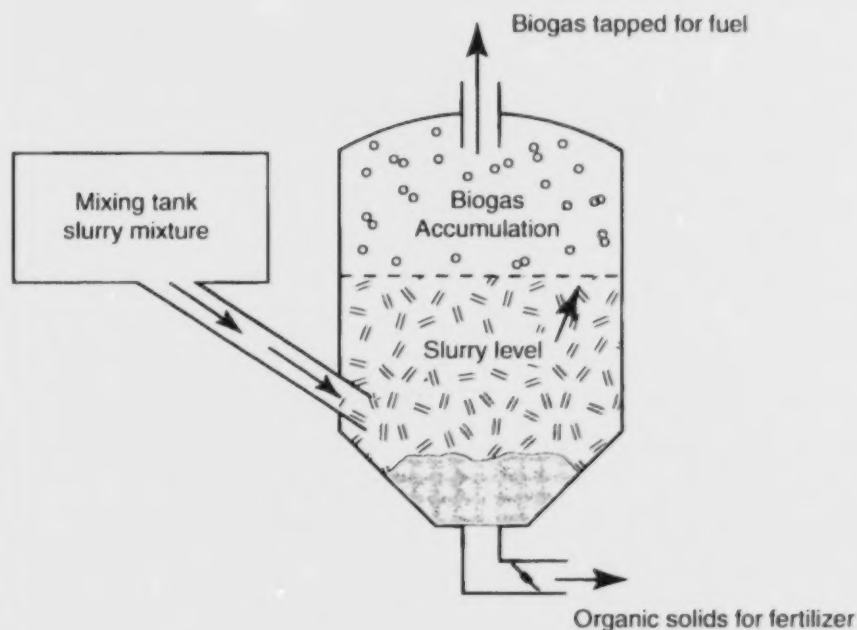
Research has shown a digester operates most efficiently at about 95 degrees Fahrenheit. Methane production does take place as low as 60 degrees F., but at 95 degrees F. the process will yield about twice as much useable fuel in a fraction of the time.

Because methane weighs about half what atmospheric air weighs, one can expect it to rise if liberated. Using that property, digester-produced methane can be trapped by covering a sewage lagoon or digester with some sort of tent-like roof. The gas can then be pumped to a storage facility or compressed into a liquid for transportation. At the same time CO_2 is roughly twice as heavy as atmospheric air, so it will normally try to settle under any methane produced.

Teacher Supplement 1

Basic methane generator design consists of a closed vessel in which a 50/50 slurry of animal manure and water can be held at roughly 95 degrees F. As the digestion process begins any oxygen in the vessel will be used by aerobic bacteria present. Once oxygen is no longer present, anaerobic bacteria will begin digesting the manure and other wastes—subsequently forming biogas which rises to the top of the vessel. By tapping this gas, one can obtain flammable methane for use as a fuel.

A cross-section illustration of a basic methane digester might appear as follows:



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Teacher Supplement 2—Build and Operate a Methane Generator

Name _____ Attempt Number _____

Date _____ Overall Rating _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Safety precautions observed	_____
• Work cooperatively with others to reach a common goal	_____
• Device performs correctly	_____
• Project summary was thorough and well written	_____

Introduction

Although methane production has been limited in the U.S. in its use as an alternative energy source, it serves as a viable replacement for natural gas and other fossil fuels. In this assignment you will study firsthand the process for methane production.

Instructions

Before beginning this activity, your instructor will divide the class into teams of 3-4 students. As a team, assign specific tasks to each team member so that everyone has an opportunity to contribute to this activity. Then, assemble a methane generator according to the specifications, and observe the process as biogas is generated from animal waste. Project summaries should be submitted by each team and team members should be prepared to discuss findings in class.

Your instructor will observe individual and group activities and rate your performance using the evaluation criteria.

Caution: The use of glass laboratory equipment carries with it the risk of breakage and possible injury from broken glass. In addition, this task involves the production of methane gas, a highly flammable and explosive substance when concentrated properly. Under no circumstance is the methane generated in this experiment to be flared without the use of a bunsen burner or other similar device. Flaring gas directly from a container can result in the flame being drawn back into the gas container—resulting in an explosion.

Equipment, and Materials

- Safety glasses
- Three (3) 2 liter Erlenmeyer flasks (or equivalent)
- Three (3) rubber stoppers capable of being fitted with glass or Tygon tubing and dial thermometer
- Glass or Tygon tubing sufficient to plumb flasks according to illustrations
- One (1) gas-tight valve fitted to glass or Tygon tubing

Teacher Supplement 2

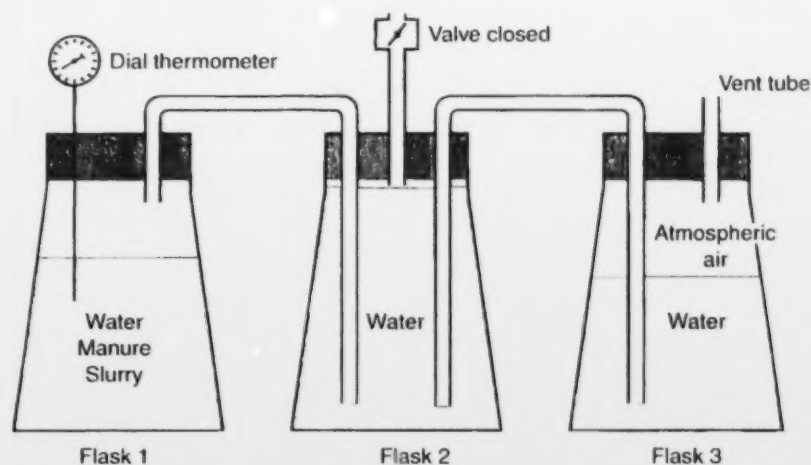
Procedure

- One (1) bunsen burner or similar device
- 1.5 liters of animal manure/water slurry
- Sufficient water to fill flasks 2 and 3 according to illustrations
- One (1) heat lamp
- One dial thermometer
- One (1) aquarium pump (or other source of very low pressure air)

Note: Read all directions before assembling anything in this experiment. Knowledge of the entire process will help you avoid accidents and better produce a useable quantity of methane gas.

- ☐ 1. Gather equipment and materials and put on safety glasses.
- ☐ 2. Assemble flasks, stoppers, tubing, valve and thermometer as shown in Figure 1.

Figure 1



- ☐ 3. Remove stoppers from flasks, install slurry material in Flask 1, and appropriate amounts of water in Flasks 2 and 3.

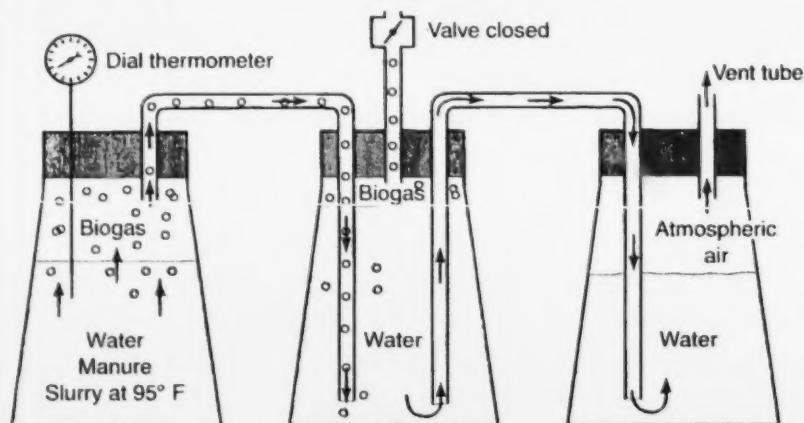
Caution: Animal manure contains bacteria and other pathogens which could be harmful to your health if ingested. Be certain to handle the material carefully and thoroughly wash your hands after completing the installation process.

- ☐ 4. Reinstall stoppers, being certain all fittings except the vent tube are air tight and valve is closed.

Teacher Supplement 2

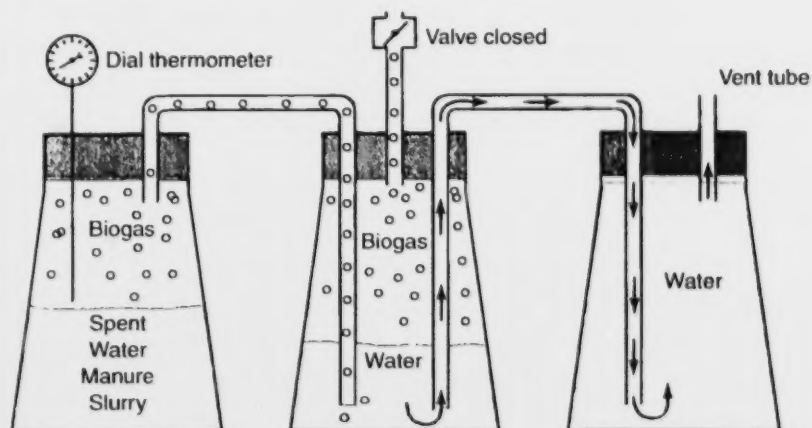
- ☐ 5. Position heat lamp near Flask 1 to maintain a 95° Fahrenheit slurry temperature. Remove safety glasses. See Figure 2.

Figure 2



- ☐ 6. Observe the apparatus over a period of days to note the displacement of water from Flask 2 into Flask 3 as biogas is generated from slurry.
- ☐ 7. Once the water level in Flask 3 is approaching or entering the vent tube, remove heat lamp from Flask 1 and prepare to tap biogas as a fuel. See Figure 3.

Figure 3

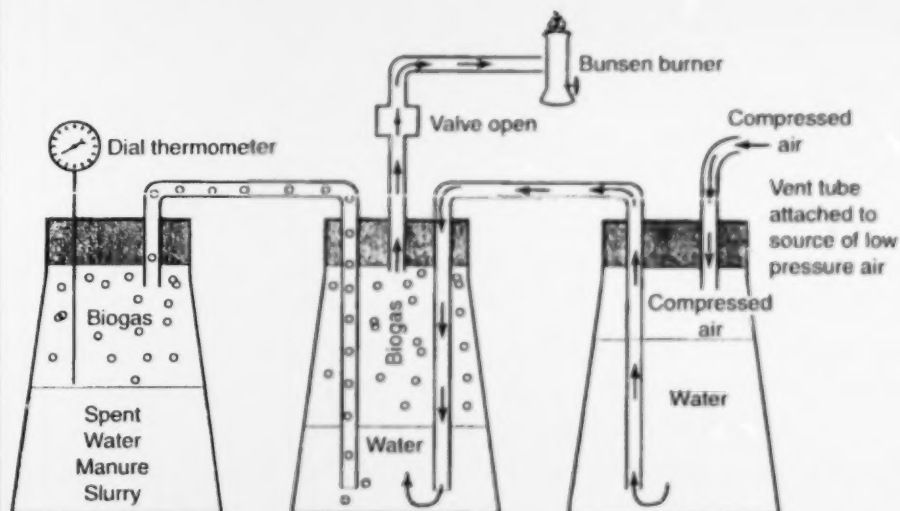


Note: Remember you will be dealing with a potentially explosive gas. Wear safety glasses at all times during the remainder of the experiment.

Teacher Supplement 2

- ☐ 8. Attach aquarium pump (or other very low pressure air source) to the vent tube. Attach necessary fittings to Flask 2's valve to connect bunsen burner. See Figure 4.

Figure 4



- ☐ 9. At the same time you apply low pressure air to the vent tube by turning on the aquarium pump, begin to open the valve from Flask 2, allowing biogas to move into the bunsen burner.
- ☐ 10. Light bunsen burner and observe the use of methane you have produced from animal waste. Once flame disappears, disconnect the aquarium pump and disassemble the entire apparatus for cleaning.

Note: Dispose of spent slurry mixture in a sanitary toilet or a compost pile.

- ☐ 11. Prepare a two-page summary of the project (as a team), including the following:
- Any problems you encountered in constructing and/or operating methane generator
 - What was observed throughout transformation process
 - Estimated quantity of gas produced
 - How methane gas might be used as an alternative energy source

Evaluator's Comments: _____

Teacher Supplement 3—Ideas for a Simple Solar Collector

Solar collectors range from simple contraptions built from scrap materials to highly sophisticated, highly-engineered commercial units costing thousands of dollars.

While one usually gets what is paid for, it's not necessary to spend thousands of dollars to make a workable solar collector which will do an outstanding job of heating air with the sun's rays. In fact, using only a minimum of purchased parts, one can make a solar panel that will easily produce 140 to 150 degree Fahrenheit air on a sunny winter afternoon.

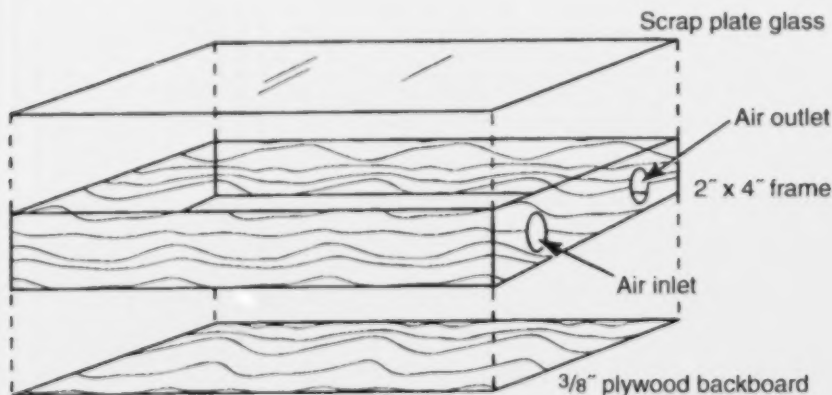
In this supplement you will see a basic air heating solar collector made from 2 x 4 x 8 boards serving as a frame, a sheet of scrap plate glass (obtainable from most glass stores who service insulated patio doors...these sheets of glass are usually permanently stained and not saleable, so you can probably obtain one for free!), a sheet of 3/8-inch or 1/2-inch plywood, some empty aluminum soft drink cans, some aluminum flashing (available at any home supply store or lumber yard) a can of black spray paint, some screws, and a tube of high-temperature silicone caulking material. With some flexible ducting and a small blower motor (such as a hair dryer with a "no heat" setting) you can build your version of this heater in an afternoon and be ready to test it the next day!

First, obtain the sheet of tempered plate glass. Most are 48 x 64 inches if they came from sliding patio doors. Others come from storm windows which have broken seals and have cloudy appearances making them unsuitable for windows—but quite useful for class project solar panels!

Using the dimensions of the plate glass, build a 2 x 4 x 8 lumber frame, and cut a piece of plywood the same size as the glass to serve as a backboard for the frame. Attach the backboard to the frame with wood screws.

Cut a 4-inch hole near both edges of one end of the frame (as shown in Figure 1).

Figure 1

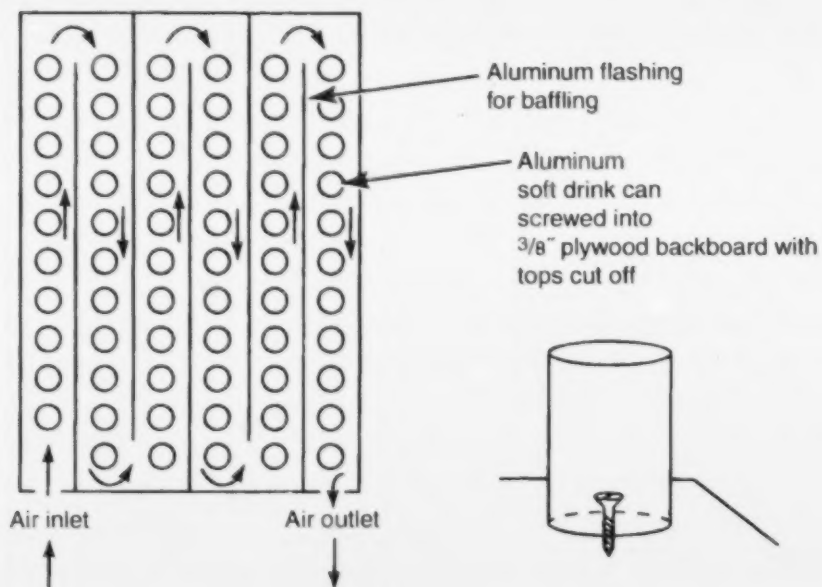


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Teacher Supplement 3

Then, using enough aluminum soft drink cans (with their tops cut off so they will fit, standing up, between the backboard and the glass when it is glued on top of the frame attach the cans in rows to the backboard (as shown in Figure 2).

Figure 2



Attach aluminum flashing between the rows of cans in an appropriate manner (bend a lip on the flashing and attach to backboard with screws) to provide a baffled flow of air through the collector.

Spray paint inside of frame, cans, and flashing with flat black paint to enhance solar collection.

Once paint is dry, run a bead of high-temperature silicone caulking (available at most hardware and mass merchandise stores for less than \$5) around the top of the frame and carefully place glass over top of frame. Caulking should cure overnight and the solar collector will be ready to use once the glass is secure.

Note: It might be advisable to nail small wooden cleats around the edge of the plate glass to prevent it from sliding one way or another should the caulking fail to hold it to the frame.

Attach flexible ducting to both the inlet and outlet and attach a small flower to the inlet duct.

With the collector positioned to face the sun, one should be able to produce a significantly hotter air at the outlet than the air being drawn into the blower near the inlet.

Teacher Supplement 4—Build and Test a Solar Collector

Name _____ Attempt Number _____

Date _____ Overall Rating _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Solar collector performed adequately	_____
• Work cooperatively with others to reach a common goal	_____
• Project summary was well-written, showing grasp of project and the operation of a solar collector	_____

Introduction

Solar collectors provide an effective method of storing and transmitting heat. Since solar heating is cleaner and it provides an alternative to other energy resources such as coal and natural gas, researchers will continue to develop more sophisticated systems that are more efficient and economical. In this activity, you still study how a simple solar collector works and compare the air temperatures at the inlet and outlet.

Instructions

Before beginning this activity, your instructor will divide the class into teams of 3-4 students. As a team, assign specific tasks to each team member so that everyone has an equal opportunity to contribute to this activity. Then, using Teacher supplement 3 as a guide, gather materials and construct a simple hot-air solar collector. (Use your imagination in selecting building materials. The cheaper the better.) Project summaries should be submitted by each team detailing the project and team members should be prepared to discuss findings in class.

Your instructor will observe individual and group activities and rate your performance using the evaluation criteria.

Equipment, and Materials

- Teacher Supplement 3
- Materials as specified in supplement or identified by team members

Procedure

- ☐ 1. Obtain materials needed to build collector.
- ☐ 2. Construct solar collector according to team plans or design presented in Teacher Supplement 3.
- ☐ 3. Test solar collector on a cold, sunny day and compare ambient air temperature with that of the outlet of the collector.

Teacher Supplement 4

- ☐ 4. Prepare a two-page summary of the project (as a team), including the following:
- Materials used to construct collector
 - Results of the test (difference in air temperature)
 - How the collector might be used to lower fuel bills
 - Recommendations on how the efficiency of the collector might be improved

Evaluator's Comments: _____

Written Test

Name _____

Date _____ Score _____

Objective 1

Match terms related to energy resources with their definitions. Write the corresponding numbers in the blanks.

- | | |
|------------------------|------------------------|
| 1. Barrel | 6. Energy reserves |
| 2. Biomass | 7. Energy resources |
| 3. Combustion | 8. Fossil fuels |
| 4. Energy | 9. Nonrenewable energy |
| 5. Energy conservation | 10. Renewable energy |

- _____ a. The capacity to do work or the ability to make things move
- _____ b. Planned management of energy resources which conserves, protects, and prevents waste
- _____ c. Hydrogen compounds derived from the remains of organisms buried millions of years ago
- _____ d. Energy resources which have not been used
- _____ e. A measure of volume of petroleum products; equal to 42 U.S. gallons
- _____ f. Resources which cannot be replaced once they are used
- _____ g. The chemical process of burning which releases heat, light, and chemical byproducts
- _____ h. Resources that can be replaced by natural regeneration or human efforts after they are used
- _____ i. A measure of national wealth by the production of usable power such as heat and electricity
- _____ j. Any plant derived organic matter available on a renewable basis

Written Test

Objective 2

Match terms used to describe energy conversion with their definitions. Write the corresponding numbers in the blanks.

- | | |
|---------------------|-----------------------------|
| 1. Kinetic energy | 3. Transformation of energy |
| 2. Potential energy | |

- _____ a. Energy due to the place or position of something.
- _____ b. Energy is constantly changing from potential energy to kinetic energy and back to potential.
- _____ c. Energy of an object or body due to its motion.

Objective 3

Classify the following energy resources as renewable (R) or nonrenewable (N) by placing the designated letters on the blanks provided.

- _____ a. Wind
- _____ b. Biomass
- _____ c. Oil
- _____ d. Solar
- _____ e. Coal
- _____ f. Uranium
- _____ g. Hydropower
- _____ h. Natural gas
- _____ i. Geothermal

Objective 4

Complete the following statements concerning coal energy resources. Circle or underline the correct words.

- a. Coal is a dark brown to black, flammable, (liquid) (solid) fossil fuel.
- b. The cost of producing electricity from coal is 10% higher than electricity produced in (nuclear) (biomass) power plants.
- c. A major environmental concern of coal use is (air pollution) (water pollution).

Written Test

Objective 5

Select true statements concerning oil energy resources. Place an "X" in the blanks next to the true statements.

- ☐ a. Oil can be refined into many products.
- ☐ b. Oil is produced by drilling a well to the resource formation.
- ☐ c. Oil is much more expensive to use than coal.
- ☐ d. Oil wells are known to pollute ground water.
- ☐ e. Using oil poses no threat to the environment.

Objective 6

Select true statements concerning natural gas energy resources. Place an "X" in the blank(s) next to the true statement(s).

- ☐ a. Natural gas is principally composed of ethane.
- ☐ b. Natural gas is generally found in the presence of oil in subsurface formations.
- ☐ c. Environmental problems associated with natural gas are minimal as compared with coal, oil, and nuclear fuels.

Objective 7

Complete the following statements concerning nuclear energy resources. Circle or underline the correct words.

- a. Uranium is a (man-made) (naturally-occurring) element.
- b. Commercial quantities of uranium are found in (Oklahoma) (Colorado).
- c. Uranium is (mined like coal) (drilled like oil).
- d. An environmental problem associated with nuclear energy is (air pollution) (radioactive waste).

Objective 8

Select true statements concerning hydropower energy resources. Place an "X" in the blanks next to the true statements.

- ☐ a. Hydropower is the process of wind turning turbines which turn alternators which generate electricity.
- ☐ b. Dams are used to harness hydropower.
- ☐ c. The U.S. is currently using only 2% of its hydropower resources.
- ☐ d. Hydropower is the most economical source of electricity.
- ☐ e. The most serious environmental concern about hydropower is air pollution.

Written Test

Objective 9

Complete statements concerning biomass energy resources. Circle or underline the correct words.

- a. Plant materials and animal (parts) (waste) are used as sources of fuel in biomass conversion.
- b. Using biomass as a direct heat source can result in serious (disease) (pollution) problems.

Objective 10

Select true statements concerning solar energy resources. Place an "X" in the blanks next to the true statements.

- _____ a. Solar collectors are used to store and transmit heat.
- _____ b. Solar systems are very economical for cooling homes and businesses.
- _____ c. Installation of solar systems is very inexpensive.
- _____ d. Solar energy is a clean source of energy.
- _____ e. Low temperature solar systems can be used to produce electricity.
- _____ f. The materials for photovoltaic devices are in limited supply.
- _____ g. The cost of the raw materials for photovoltaic cells is the reason that photovoltaic systems are expensive.

Objective 11

Complete statements concerning wind energy resources. Circle or underline the correct words.

- a. Wind energy is usually harnessed by (wind machines) (air turbines).
- b. Wind energy (is) (is not) very damaging to the environment.
- c. Small windmill systems have (a promising future) (no future) in small communities, farms, or rural homes.

Objective 12

Select true statements concerning geothermal energy resources. Place an "X" in the blanks next to the true statements.

- _____ a. Geothermal energy is produced by drilling wells to underground steam formations.
- _____ b. Electricity produced from geothermal sources is very expensive compared to other energy sources.
- _____ c. Geothermal energy is very clean and creates no pollution problems.
- _____ d. Most geothermal resources are located in the South.

Written Test

Objective 13

Match U.S. energy resources with their correct reserve supplies. Write the corresponding numbers in the blanks.

- | | | |
|---------------|----------------|------------|
| 1. Coal | 3. Natural gas | 5. Uranium |
| 2. Hydropower | 4. Oil | |

- _____ a. U.S. has 4% of the world's supply
- _____ b. U.S. has 25% of the world's supply
- _____ c. U.S. has enough for 54 years
- _____ d. U.S. has enough for 300 years

Objective 14

Draw a pie chart showing the use of oil resources in the United States.

Objective 15

Select from the following list the goals of energy conservation by placing an "X" next to the appropriate goals.

- _____ a. To save money
- _____ b. To produce more energy sources
- _____ c. To use more energy
- _____ d. To improve the environment by reducing harmful emissions
- _____ e. To reduce our reliance on foreign energy for political and economic reasons

Written Test

Objective 16

Select true statements concerning ways to conserve energy. Place an "X" in the blanks next to the true statements.

- _____ a. Insulate and weather-strip existing homes.
- _____ b. Keep door and windows open for ventilation.
- _____ c. Use car pools.
- _____ d. Increase vehicle speeds only on the highway.
- _____ e. Walk or ride a bicycle.
- _____ f. Recycle raw products.
- _____ g. Lower the thermostat setting in the summer.
- _____ h. Turn off lights when not needed.

Objective 17

List three career opportunities related to energy resources.

- a. _____
- b. _____
- c. _____

*Permission to duplicate this test is granted.

Written Test—Answer Key

Objective 1

Match terms related to energy resources with their definitions. Write the corresponding numbers in the blanks.

- | | |
|------------------------|------------------------|
| 1. Barrel | 6. Energy reserves |
| 2. Biomass | 7. Energy resources |
| 3. Combustion | 8. Fossil fuels |
| 4. Energy | 9. Nonrenewable energy |
| 5. Energy conservation | 10. Renewable energy |

- 4 a. The capacity to do work or the ability to make things move
- 5 b. Planned management of energy resources which conserves, protects, and prevents waste
- 8 c. Hydrogen compounds derived from the remains of organisms buried millions of years ago
- 6 d. Energy resources which have not been used
- 1 e. A measure of volume of petroleum products; equal to 42 U.S. gallons
- 9 f. Resources which cannot be replaced once they are used
- 3 g. The chemical process of burning which releases heat, light, and chemical byproducts
- 10 h. Resources that can be replaced by natural regeneration or human efforts after they are used
- 7 i. A measure of national wealth by the production of usable power such as heat and electricity
- 2 j. Any plant derived organic matter available on a renewable basis

Written Test—Answer Key

Objective 2

Match terms used to describe energy conversion with their definitions. Write the corresponding numbers in the blanks.

- | | |
|---------------------|-----------------------------|
| 1. Kinetic energy | 3. Transformation of energy |
| 2. Potential energy | |

- 2 a. Energy due to the place or position of something.
- 3 b. Energy is constantly changing from potential energy to kinetic energy and back to potential.
- 1 c. Energy of an object or body due to its motion.

Objective 3

Classify the following energy resources as renewable (R) or nonrenewable (N) by placing the designated letters on the blanks provided.

- R a. Wind
- R b. Biomass
- N c. Oil
- R d. Solar
- N e. Coal
- N f. Uranium
- R g. Hydropower
- N h. Natural gas
- R i. Geothermal

Objective 4

Complete the following statements concerning coal energy resources. Circle or underline the correct words.

- a. Coal is a dark brown to black, flammable, (liquid) **(solid)** fossil fuel.
- b. The cost of producing electricity from coal is 10% higher than electricity produced in **(nuclear)** (biomass) power plants.
- c. A major environmental concern of coal use is **(air pollution)** (water pollution).

Written Test—Answer Key

Objective 5

Select true statements concerning oil energy resources. Place an "X" in the blanks next to the true statements.

- ☒ a. Oil can be refined into many products.
- ☒ b. Oil is produced by drilling a well to the resource formation.
- ☐ c. Oil is much more expensive to use than coal.
- ☒ d. Oil wells are known to pollute ground water.
- ☐ e. Using oil poses no threat to the environment.

Objective 6

Select true statements concerning natural gas energy resources. Place an "X" in the blank(s) next to the true statement(s).

- ☐ a. Natural gas is principally composed of ethane.
- ☒ b. Natural gas is generally found in the presence of oil in subsurface formations.
- ☒ c. Environmental problems associated with natural gas are minimal as compared with coal, oil, and nuclear fuels.

Objective 7

Complete the following statements concerning nuclear energy resources. Circle or underline the correct words.

- a. Uranium is a (man-made) (**naturally-occurring**) element.
- b. Commercial quantities of uranium are found in (Oklahoma) (**Colorado**).
- c. Uranium is (**mined like coal**) (drilled like oil).
- d. An environmental problem associated with nuclear energy is (air pollution) (**radioactive waste**).

Objective 8

Select true statements concerning hydropower energy resources. Place an "X" in the blanks next to the true statements.

- ☐ a. Hydropower is the process of wind turning turbines which turn alternators which generate electricity.
- ☒ b. Dams are used to harness hydropower.
- ☐ c. The U.S. is currently using only 2% of its hydropower resources.
- ☒ d. Hydropower is the most economical source of electricity.
- ☐ e. The most serious environmental concern about hydropower is air pollution.

Written Test—Answer Key

Objective 9

Complete statements concerning biomass energy resources. Circle or underline the correct words.

- a. Plant materials and animal (parts) **(waste)** are used as sources of fuel in biomass conversion.
- b. Using biomass as a direct heat source can result in serious (disease) **(pollution)** problems.

Objective 10

Select true statements concerning solar energy resources. Place an "X" in the blanks next to the true statements.

- X a. Solar collectors are used to store and transmit heat.
- b. Solar systems are very economical for cooling homes and businesses.
- c. Installation of solar systems is very inexpensive.
- X d. Solar energy is a clean source of energy.
- e. Low temperature solar systems can be used to produce electricity.
- f. The materials for photovoltaic devices are in limited supply.
- g. The cost of the raw materials for photovoltaic cells is the reason that photovoltaic systems are expensive.

Objective 11

Complete statements concerning wind energy resources. Circle or underline the correct words.

- a. Wind energy is usually harnessed by **(wind machines)** (air turbines).
- b. Wind energy (is) **(is not)** very damaging to the environment.
- c. Small windmill systems have **(a promising future)** (no future) in small communities, farms, or rural homes.

Objective 12

Select true statements concerning geothermal energy resources. Place an "X" in the blanks next to the true statements.

- X a. Geothermal energy is produced by drilling wells to underground steam formations.
- b. Electricity produced from geothermal sources is very expensive compared to other energy sources.
- c. Geothermal energy is very clean and creates no pollution problems.
- d. Most geothermal resources are located in the South.

Written Test—Answer Key

Objective 13

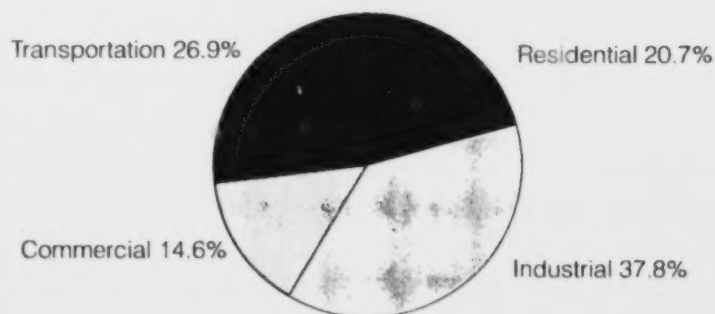
Match U.S. energy resources with their correct reserve supplies. Write the corresponding numbers in the blanks.

- | | | |
|---------------|----------------|------------|
| 1. Coal | 3. Natural gas | 5. Uranium |
| 2. Hydropower | 4. Oil | |

- 4 a. U.S. has 4% of the world's supply
- 1 or 5 b. U.S. has 25% of the world's supply
- 3 c. U.S. has enough for 54 years
- 1 or 5 d. U.S. has enough for 300 years

Objective 14

Draw a pie chart showing the uses of oil resources in the United States.



Objective 15

Select from the following list the goals of energy conservation by placing an "X" next to the appropriate goals.

- X a. To save money
- b. To produce more energy sources
- c. To use more energy
- X d. To improve the environment by reducing harmful emissions
- X e. To reduce our reliance on foreign energy for political and economic reasons

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Written Test—Answer Key

Objective 16

Select true statements concerning ways to conserve energy. Place an "X" in the blanks next to the true statements.

- ☒ a. Insulate and weather-strip existing homes.
- ☐ b. Keep door and windows open for ventilation.
- ☒ c. Use car pools.
- ☐ d. Increase vehicle speeds only on the highway.
- ☒ e. Walk or ride a bicycle.
- ☒ f. Recycle raw products.
- ☐ g. Lower the thermostat setting in the summer.
- ☒ h. Turn off lights when not needed.

Objective 17

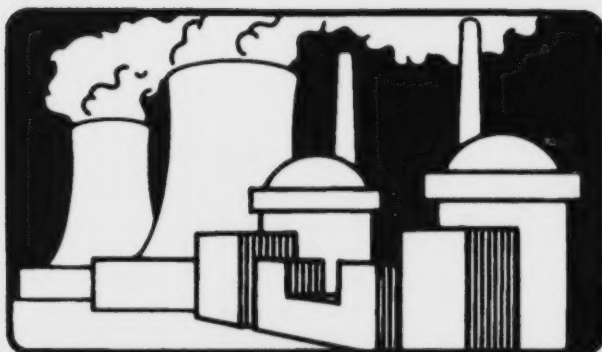
List three career opportunities related to energy resources.

Any three of the following:

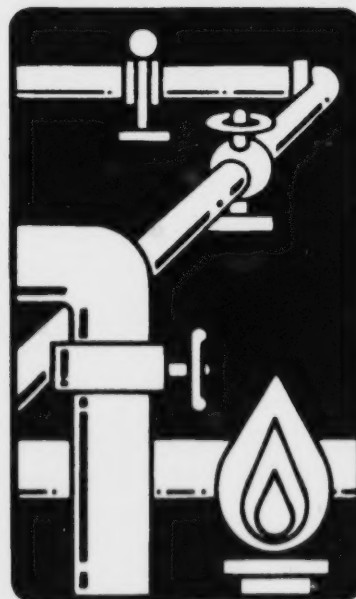
- Engineer
- Geologist
- Chemist
- Physicist
- Mineralogist
- Scientist

*Permission to duplicate this test is granted.

Nonrenewable Energy Resources



Uranium (Nuclear)



Natural Gas



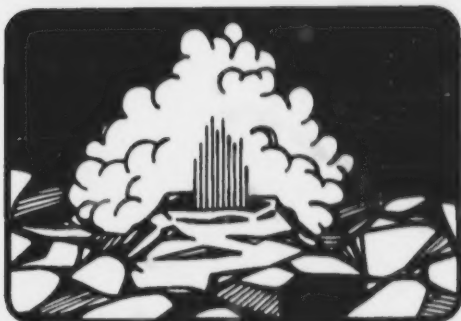
Coal



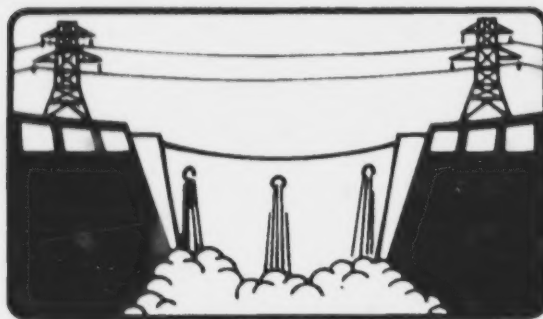
Oil

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Renewable Energy Resources



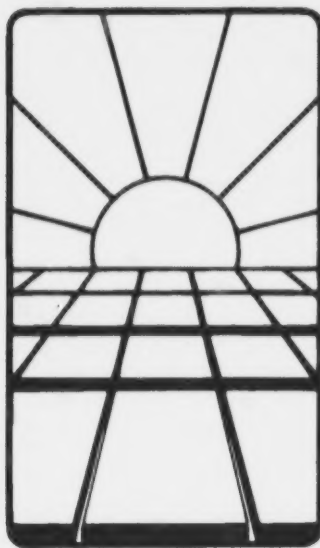
Geothermal



Hydropower (Water)



Biomass



Solar

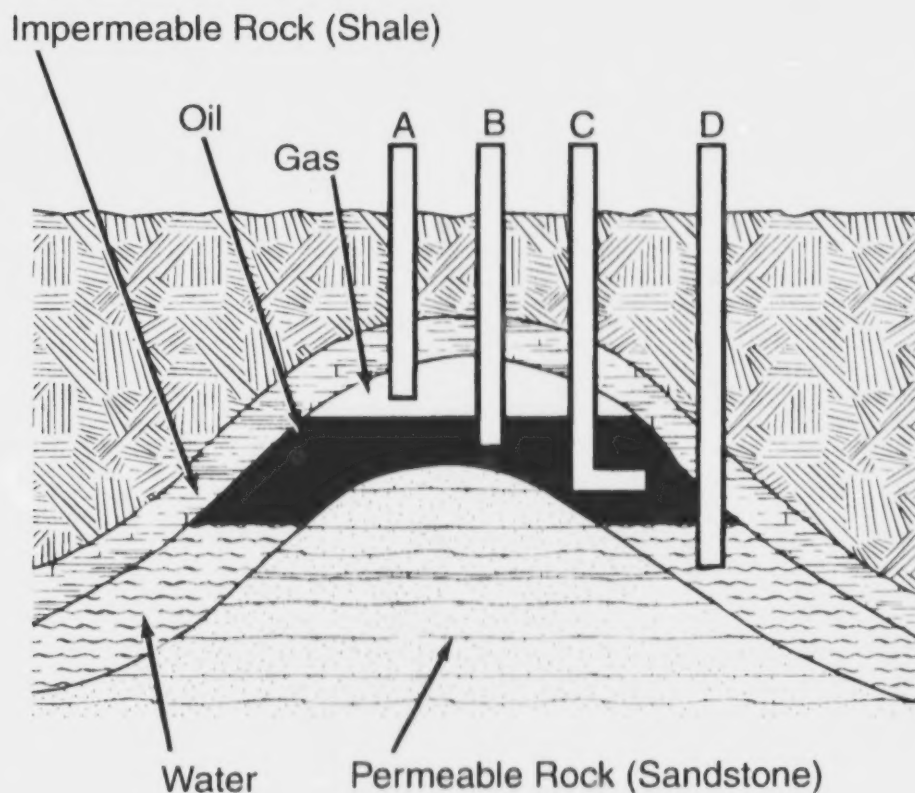


Wind

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TM 2

Oil and Gas Production



Well A — Gas Well

Well B — Conventional Oil Well

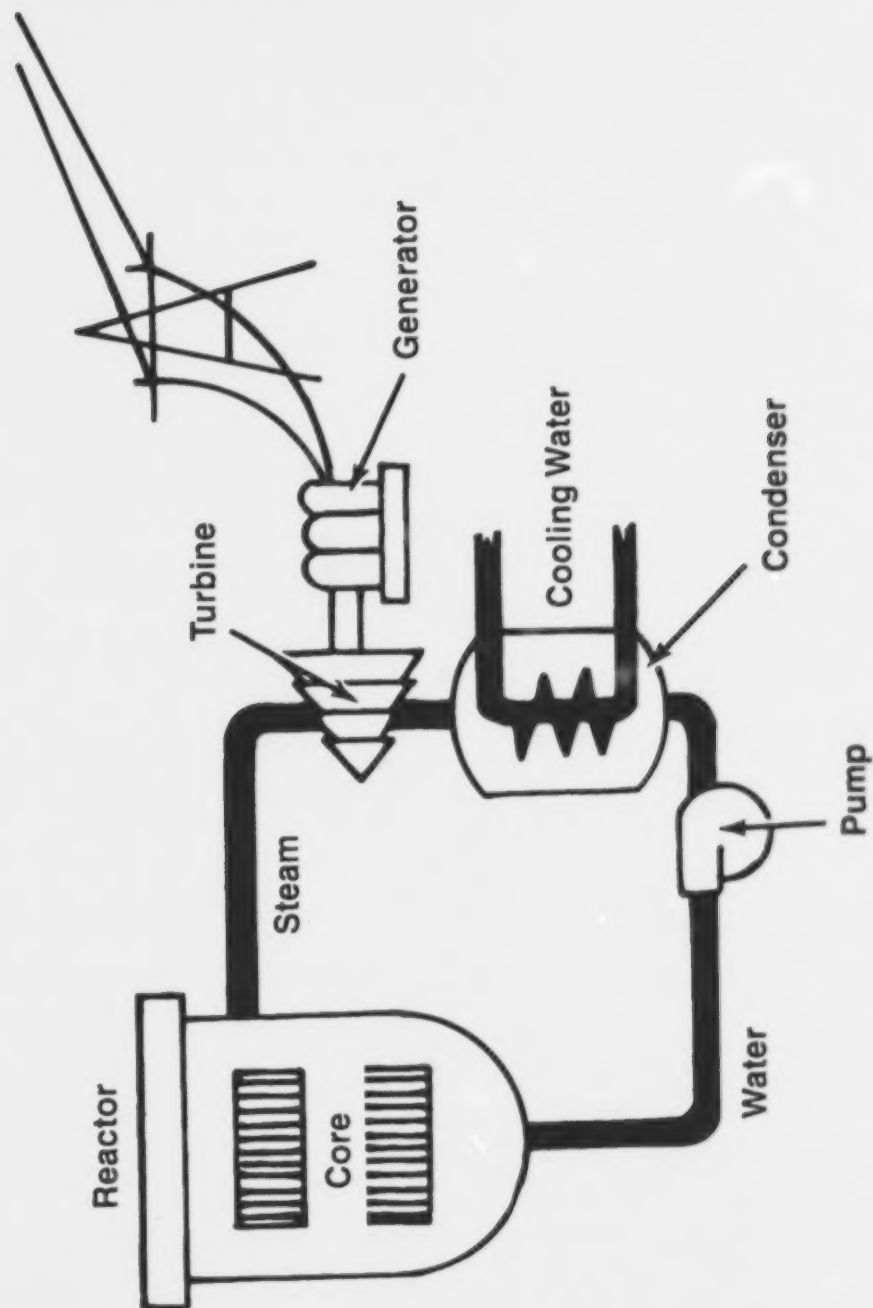
Well C — Horizontally Drilled Oil Well (increases production)

Well D — Water Well

Note: Layers of rock trap oil and natural gas

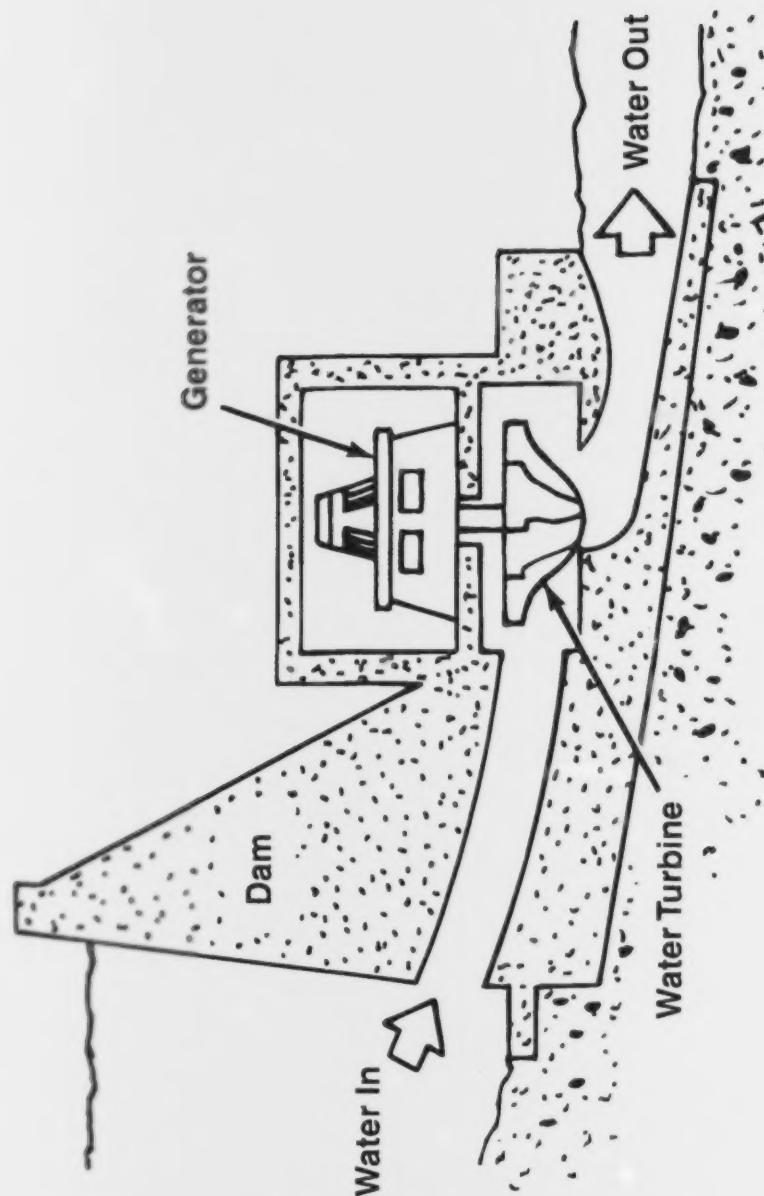
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Nuclear Energy Production



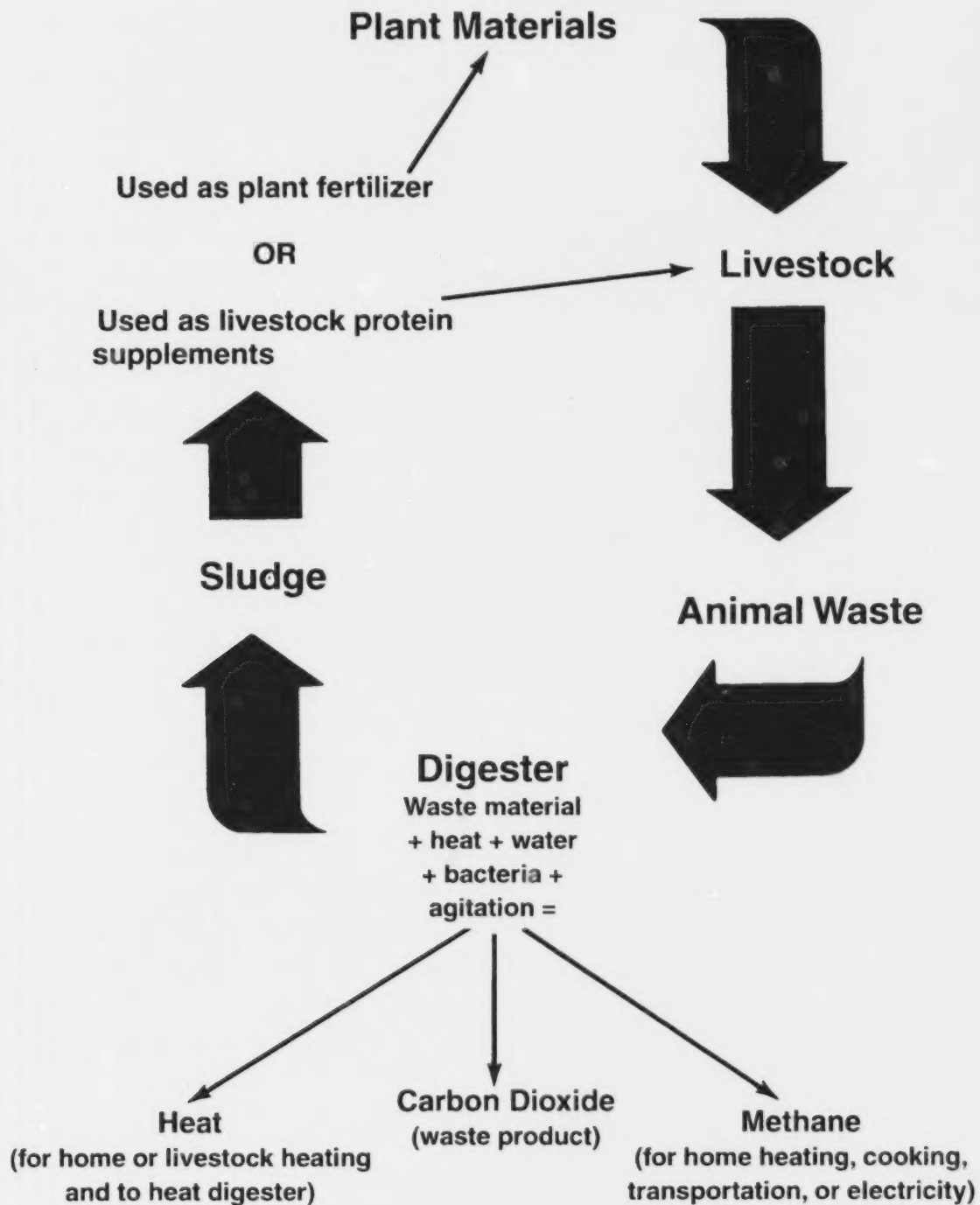
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Hydropower Production

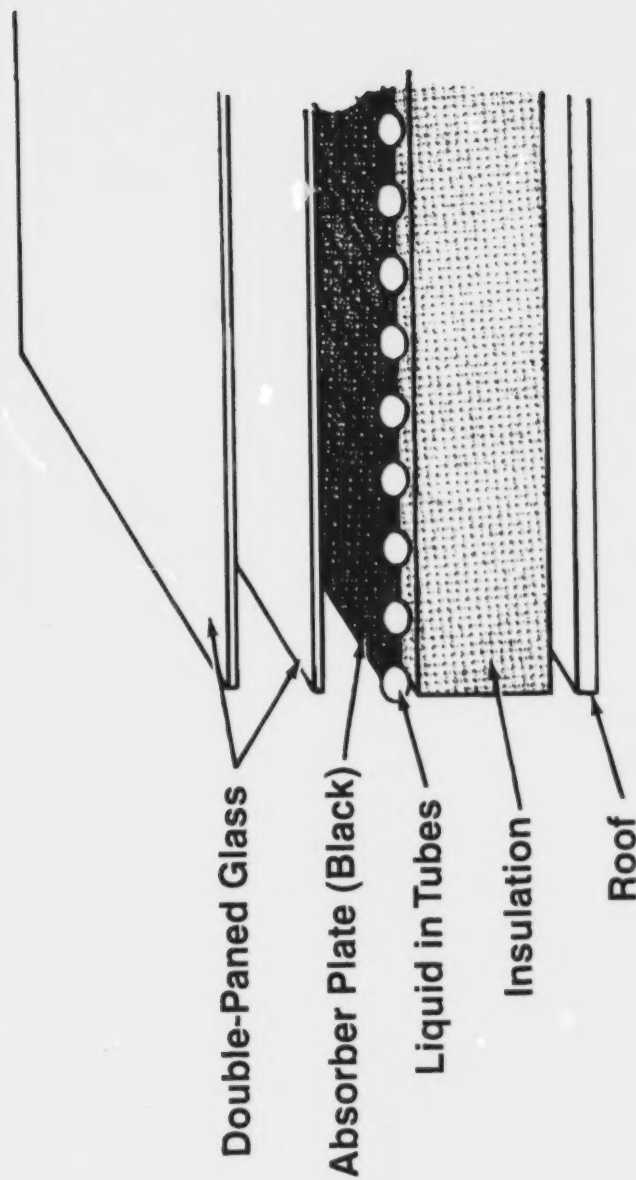


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Biomass Conversion



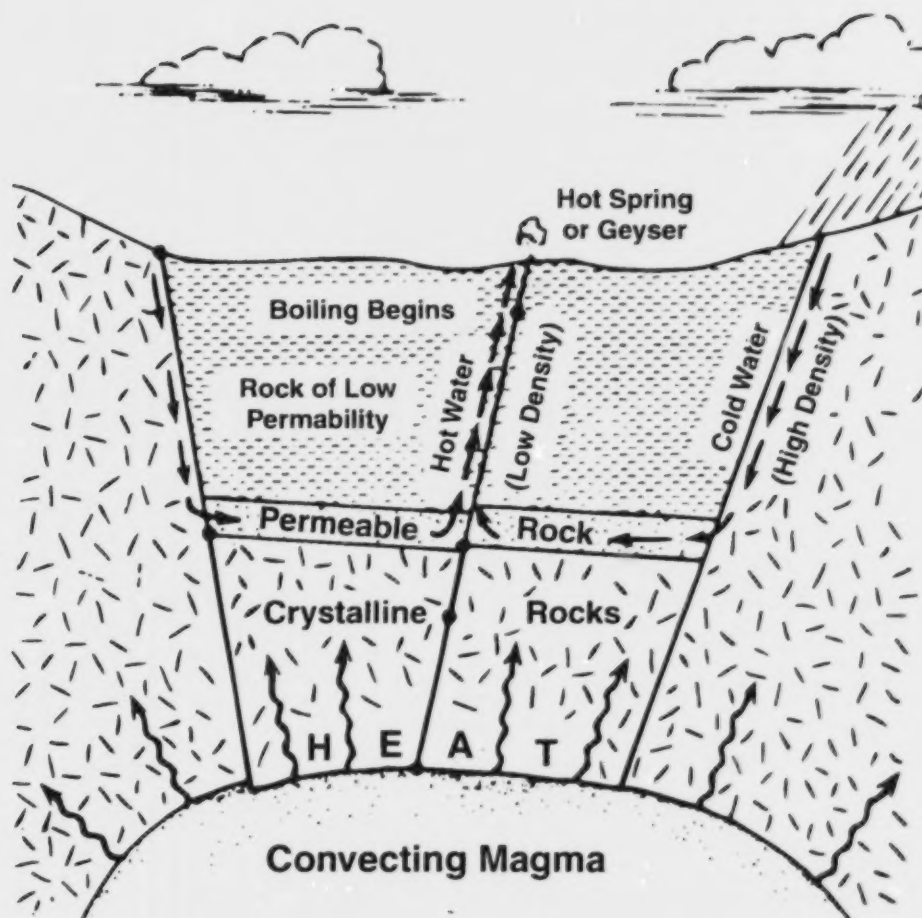
Solar Collector Panel



NOTE: Heat from sun is absorbed by liquid in absorber plate. Heat is transported through building.

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Geothermal Reservoir



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Instructional
Plan

Suggested Activities

Preparation

- Review the objective sheet. Study the specific objectives to determine the order in which you will present the objectives.
- Review the suggested lesson plan. The plan identifies an order for instruction to take place. Each "day" represents a 50-minute class period. The plan is designed to cover the specific objectives over a 15-day period. Additional days and/or activities may be added. (Note: You may want to change days to specific dates. Example: Day 1 may become Monday, March 1, Day 2 = Tuesday, March 3, and so forth.) You will want to localize, supplement, and personalize the plan to fit your situation.
- Review the teaching suggestions included in this instructional plan section to plan classroom activities. Also note the suggestions for supplemental resources.
- Plan your delivery/application to take advantage of student learning styles and to accommodate special-needs students.
- Obtain films, videotapes, and other media to supplement instruction of this unit. See "Resources Used in Developing this Unit" and "Suggested Supplemental Resources" for more information.
- Make transparencies or computer presentation from the transparency masters included in this unit. These appear in the teacher edition only and should be used with objectives as indicated below.

TM 1—Main Parts of a Tree (Objectives 3, 4, 5, and 6)

TM 2—Classifications of Trees (Objective 10)

TM 3—Forest Regions of the United States (Objective 14)

- Select teacher components (written test, unit review) you want to distribute to your students. Copy and prepare these components for distribution.
- Prepare classroom. Put up posters and charts and display articles and other references related to the objectives of this unit.

Suggested Activities

Delivery and Application

- Discuss unit and specific objectives.
- Discuss information sheets. Implement teaching plan to localize, supplement, and personalize the unit. Reinforce basic academic and workplace skills when applicable.
- Discuss the assignment sheets and job sheets. Review with students the criteria for evaluation of each of these activities.

Teaching Suggestions

The skill areas appearing in bold-face type in the teaching suggestions refer to the academic and workplace skills identified in What Work Requires of Schools: A SCANS Report for America 2000 and Workplace Basics: The Skills Employers Want. These have been adapted by MAVCC.

- Arrange for representatives of your state's forestry department or foresters from your state's land-grant university's Cooperative Extension Service to visit the class to discuss the suitability of certain trees in various settings; careers in forestry; forest management and public policy; and economic potential of home or farm forestry projects. (**Listening; acquiring scientific information; career awareness; reasoning**)
- Meet with and enlist local land and property owners who would allow class members to use their property to survey timber stands, forestry practices, etc.
- Have students collect and exhibit common tree leaves from your local area, identifying and classifying the trees according to their genus, species, etc. (**Comprehending written information and analyzing it; applying what has been read to a specific task; writing; critical thinking**)
- Involve the class members with a science or biology class in a tree planting project. (**Organizational effectiveness; teamwork; leadership**)
- Work with your county's land-grant university agricultural agent, a representative of your state's forestry service, or a member of a federal forestry agency. Seek out local "tree farmers" and arrange for a visit of their operation to become familiar with the investment necessary, and the profit potential from a long-term forestry crop. Have students take notes and write a report detailing their findings and opinion as to why they would or would not enter into a similar operation if they had the necessary land and capital. (**Listening; writing; critical thinking; reasoning**)

Suggested Activities

- Supply students with several cross-section cuts of tree trunks to allow them to count annular rings in aging the tree (Assignment Sheet 2). Use the opportunity to discuss what the size of the rings may tell about the growing season of the particular tree in question.
- Visit a saw mill, paper mill, or logging site. Encourage students to ask questions during the visit and assign them a report detailing what they learned on the outing. (**Listening; writing; critical thinking**)
- Discuss wood measurements, detailing the standard cord measurement vs. a "rick" or a "face cord," so often used in firewood measure. Assign the students math problems dealing with cord measures. (**Solving mathematical problems; listening**)

Evaluation

- Give and evaluate Forestry Review.
- Copy written test and give to students as pretest.
- Evaluate assignment sheets. See the evaluation criteria listed at the top of each assignment sheet and the component "Answers to Assignment Sheets." Evaluation may be localized, personalized, or individualized to fit your situation. Record student's grade in your grade book.
- Evaluate job sheets. See the evaluation criteria listed at the top of each job sheet. Evaluation may be localized, personalized, or individualized to fit your situation. Record student's grade in your grade book.
- Give and evaluate written test. Record student's written test score in your grade book and on the student's competency profile.
- Measure competency gains by comparing written pretest scores with posttest scores.
- Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas of improvement.
- Reteach and retest as required.

Suggested Activities

Instructions for Evaluating Student Performance

- When the student is ready to perform a specific task, obtain a copy of the assignment sheet or the job sheet which may be found in the student workbook.
- Assignment Sheets—Once the student has completed an assignment sheet, evaluate the student's work using the evaluation criteria. If the student's work is unsatisfactory, have the student review the assignment sheet and submit their work for evaluation again. Record the appropriate level of competency on the student's competency profile.
- Job Sheets—A student may be evaluated for process, product, or both.

Process evaluation—Place a mark in the box to the left of each designated checkpoint if the student has satisfactorily achieved the step(s) for each checkpoint area. If the student is unable to correctly complete the procedure, have the student review the materials and try again.

Product evaluation—Once the student has satisfactorily completed the procedure, rate the student product (outcome) using the criteria which have been provided as part of the job sheet. If the student's product is unacceptable, have the student review the materials and submit another product for evaluation.

- Sample performance evaluation keys have been provided below. Many other keys are available. Select one rating (grading scale) which best fits your program needs.

Sample A

- 4—**Skilled**—Can perform job with no additional training.
- 3—**Moderately skilled**—Has performed job during training program; limited additional training may be required.
- 2—**Limited skill**—Has performed job during training program; additional training is required to develop skill.
- 1—**Unskilled**—Is familiar with process, but is unable to perform job.
- 0—**No exposure**—No information or practice provided during training program.

Sample B

- Yes**—Can perform job with no additional training.
- No**—Is unable to perform job satisfactorily.

- Encourage students to continue their portfolio. The portfolio should become a record of the student's progress in the study of natural resources.

Suggested Activities

Resources Used in Developing This Unit

Note: URLs change frequently. Any of the web sites listed may have moved.

- Camp, William G. and Thomas B. Daugherty. *Managing Our Natural Resources (4th Edition)*. Albany, NY: Delmar Publishers Inc., 2002.
www.agriscience.delmar.com
- Lee, Jasper S., *Natural Resources and Environmental Technology*, Danville, IL: Interstate Publishers, Inc., 2000.
www.interstatepublishers.com
- *Forestry*, Stillwater, OK: Curriculum and Instructional Materials Center, 1998.
www.okcareertech.org/cimc

Suggested Supplemental Resources

Print Media

- American Forest Foundation
1111 19th Street, Suite 780, NW
Washington, D.C. 20036
Phone: 202-463-2462
www.affoundation.org

The American Forest Foundation is a nonprofit education and conservation organization working for health forests, quality environmental education, and to help people make informed decisions about our communities and our world.

AFF sponsors:

- Project Learning Tree (www.plt.org): to obtain teacher and student materials you must attend a Project Learning Tree (PLT) workshop. Contact your state conservation, natural resource, or forestry department for more information on these workshops.
- American Tree Farm System (www.treefarmssystem.org): promotes sustaining forests, watersheds, and healthy habitats through the power of private stewardship.

- Society of American Foresters
5400 Grosvenor Lane
Bethesda, MD 20814
Phone: 301-897-3690
www.safnet.org

SAF is the national scientific and educational organization representing the forestry profession in the United States.

- Forest History Society
701 Wm. Vickers Avenue
Durham, NC 27701
Phone: 919-682-9319
www.lib.duke.edu/forest

Suggested Activities

The Forest History Society is affiliated with Duke University. It links the past to the future by identifying information on the history of interactions between people, forests, and their related resource—timber, water, soil, forage, fish, and wildlife, recreation, and scenic or spiritual values.

- USDA U.S. Forest Service
P.O. Box 96090
Washington, D.C. 20090
Phone: 202-205-8333
www.fs.fed.us

"Working for the Great Outdoors", the Forest Service provides resources for the conservation and utilization of forests. Much of the Forest Service responsibilities involve collaboration with other Federal and State agencies, local communities, private and tribal landowners, university research centers, and international organizations.

- *OKPlantID* — Oklahoma State University site. Provides students the opportunity to see various aspects of a wide variety of plants, including the leaves, bark, buds, fruit, and flowers. <http://okplantid.okstate.edu> or www.okstate.edu then go to search for: okplantid
- U.S. Department of Interior
1849 C. St., NW
Washington, D.C. 20240
www.doi.gov

Responsible for agencies that manage public land.

- The National Park Service
1849 C Street, NW
Washington, D.C. 20240
Phone: 202-208-6843
www.nps.gov

LearnNPS (www.nps.gov/learn) is the place to go to learn more about the national park system. Serves all teachers and learners. School Zone—curriculum based learning tools; Parks as classrooms. Teacher Zone—Teaching resources; Workshops, skills development. Go Zone - On-line activities, fun and games; Post your work. Ranger Zone - Park Junior Ranger programs.

- Bureau of Land Management (www.blm.gov) — manages land owned by the federal government. Check out "Just for Teachers" site.
- Forestinformation.com
www.forestinformation.com

Resource for forest facts such as forest statistics, forest terms, satellites and forests, and forest links. Also, site has games for students and curriculum resources for teachers.

Suggested Lesson Plan**Day 1**

Introduction:

- Discuss unit objective and review specific objectives and plan for completing this unit.
- Have student read the introduction and discuss their experiences with forests.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 2—Statements related to forestry.
- Discuss Objective 3—Main parts of a tree.
- Use TM 1 to illustrate main parts of a tree.
- Discuss Objective 4—Parts of the crown.
- Use TM 1 to illustrate parts of the crown.

Closure:

- Review introduction and Objective 2.

Evaluation:

- Non-applicable.

Day 2

Introduction:

- Review Objectives 3 and 4.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 5—Parts of the trunk.
- Use TM 1 to illustrate parts of the trunk.
- Discuss Objective 6—Types of roots and their functions.
- Use TM 1 to illustrate types of roots.
- Discuss Objective 7—Ways trees are identified.
- Assign Assignment Sheet 1—Identify Local Trees
 - Discuss Introduction and directions.
 - Review evaluation criteria.
 - Identify resources that will be used to identify leaf samples.
 - Discuss how to mount leaf samples.
 - Discuss how to label.
 - Due date: Day 6

Closure:

- Review Objectives 5 and 6.

Evaluation:

- Non-applicable.

Suggested Lesson Plan

Day 3

Introduction:

- Review Objective 7.
- Review Assignment Sheet 1.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 8—Photosynthesis.
- Discuss Objective 9—Growth of a tree.
- Complete Assignment Sheet 2—Determine the Age of a Tree
 - Read introduction and directions.
 - Review evaluation criteria.
 - If possible, bring several cross-sections of trees to class to aid in determining age.
 - Complete assignment sheet.
- Turn in Assignment Sheet 2.

Closure:

- Review Objective 8.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 2 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 2 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Day 4

Introduction:

- Return Assignment Sheet 2. Discuss, if necessary.
- Review progress on Assignment Sheet 1.
- Review Objective 9.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 10—Classification of trees.
- Use TM 2 to illustrate classification of trees.
- Discuss Objective 11 — Common uses of trees.
- Assign Assignment Sheet 3—Determine Uses of Wood and Wood By-Products
 - Discuss introduction and directions.
 - Discuss evaluation criteria.
 - Provide examples of wood or wood by-products.
 - Have students bring examples of wood or wood by-products to next class.
 - Due date: next class.

Closure:

- Review Objective 10.
- Remind students that Assignment Sheet 3 will be due at next class.

Evaluation:

- Non-applicable.

Suggested Lesson Plan

Day 5

Introduction:

- Review Objective 11.
- Review progress on Assignment Sheets 1 and 3.
- State the objectives for today's lesson.

Delivery and Application:

- Provide supervised study for students to complete Assignment Sheet 3 and research Assignment Sheet 1.
- Turn in Assignment Sheet 3.

Closure:

- Remind students that Assignment Sheet 1 is due at next class. Students should be prepared to discuss tree names and classifications.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 3 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 3 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Day 6

Introduction:

- Return Assignment Sheet 3. Discuss, if necessary.
- Review progress on Assignment Sheet 1.
- State the objectives for today's lesson.

Delivery and Application:

- Provide supervised study for completion of Assignment Sheet 1.
- Have students display and discuss their leaf samples, names and classifications.

Closure:

- Turn in Assignment Sheet 1.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 1 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 1 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Day 7

Introduction:

- Return Assignment Sheet 1. Discuss, if necessary.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 12—Benefits of forests to the environment.
- Discuss Objective 13—Government forestry agencies.
- Discuss Objective 14—Major forest regions of the United States.
- Use TM 3 to illustrate the major regions.
- Discuss Objective 15—Types of forest cuttings.

Suggested Lesson Plan

Day 8

Closure:

- Review Objectives 12, 13, and 14.

Evaluation:

- Non-applicable.

Introduction:

- Review Objective 15.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 16—Ways that tree stands regenerate.
- Complete Job Sheet 1—Plant a Bareroot Tree.
 - Discuss introduction and directions.
 - Review equipment needed and procedure.
 - Demonstrate planting a bareroot tree.
 - Have students return demonstration.
 - Guided practice, if applicable.
- Note: May need an extra day for all students to complete return demonstration and guided practice.
- Turn in Job Sheet 1.

Closure:

- Review Objective 16.

Evaluation:

- Evaluate each student's performance on Job Sheet 1 according to criteria stated on assignment sheet.
- Record student's Job Sheet 1 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Day 9

Introduction:

- Return Job Sheet 1. Discuss, if necessary.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 17—Forest measurements.
- Have students complete Assignment Sheet 4—Solve Cord Measurement Problems.
 - Discuss introduction and directions.
 - Have students complete Assignment Sheet 4.
 - Discuss problems.
- Turn in Assignment Sheet 4.
- Assign Assignment Sheet 6—Analyze Current Reports Concerning Areas of Conflict in Forestry.
 - Discuss introduction and directions.
 - Review evaluation criteria.
 - Have students review Assignment Sheet 5 for possible ideas for topics.
 - Due date: Day 15.

Suggested Lesson Plan

Day 10

Closure:

- Review Objective 17.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 4 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 4 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Introduction:

- Return Assignment Sheet 4. Discuss, if necessary.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 18—Measuring instruments used in forestry.
- Complete Job Sheet 2—Measure Diameter of a Tree.
 - Discuss introduction and directions.
 - Review equipment needed and procedure.
 - Demonstrate measuring diameter of a tree.
 - Have students return demonstration.
 - Guided practice, if applicable.
- Complete Job Sheet 3—Measure Merchantable Height of a Tree.
 - Discuss introduction and directions.
 - Review equipment needed and procedure.
 - Demonstrate measuring merchantable height of a tree.
 - Have students return demonstration.
 - Guided practice, if applicable.

Closure:

- Turn in Job Sheets 2 and 3.
- Review Objective 18.

Evaluation:

- Evaluate each student's performance on Job Sheet 2 according to criteria stated on assignment sheet.
- Record student's Job Sheet 2 grade in grade book.
- Record appropriate competency level on each student's competency profile.
- Evaluate each student's performance on Job Sheet 3 according to criteria stated on assignment sheet.
- Record student's Job Sheet 3 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Suggested Lesson Plan

Day 11

Introduction:

- Return Job Sheets 2 and 3. Discuss, if necessary.
- Review progress on Assignment Sheet 6.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 19—Forest (tree) enemies.
- Discuss Objective 20—Causes of fire.
- Discuss Objective 21—Types of forest fires.
- Discuss Objective 22—Categories of forest fires.
- Discuss Objective 23—Benefits of controlled burns.
- Discuss Objective 24—Career opportunities in forestry.

Closure:

- Review Objectives 19 through 21.

Evaluation:

- Non-applicable.

Day 12

Introduction:

- Review progress on Assignment Sheet 6.
- Remind students of written test on Day 14.
- State the objectives for today's lesson.

Delivery and Application:

- Complete Assignment Sheet 5—Analyze Areas of Conflict in Maintaining Forests and Urban Trees.
 - Discuss introduction and directions.
 - Lead class discussion on each conflict.
 - Allow students time to write an answer for each conflict.

Closure:

- Turn in Assignment Sheet 5.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 5 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 5 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Day 13

Introduction:

- Return Assignment Sheet 5. Discuss, if necessary.
- Review progress on Assignment Sheet 6.
- Remind students of written test in next class.
- State the objectives for today's lesson.

Delivery and Application:

- Complete Forestry Review.
- Turn in Forestry Review.
- Provide supervised study for Assignment Sheet 6 and to review for test.

Suggested Lesson Plan

Day 14

Closure:

- Remind students of written test during next class.

Evaluation:

- Evaluate each student's performance on Forestry Review according to criteria stated on assignment sheet.
- Record student's Forestry Review grade in grade book.

Introduction:

- Return Forestry Review. Discuss, if necessary.
- Review for written test.
- State the objectives for today's lesson.

Delivery and Application:

- Give written test.
- Turn in written test.
- Have students that have completed written test work on Assignment Sheet 6.

Closure:

- Review expectations for Assignment Sheet 6.

Evaluation:

- Evaluate each student's performance on written test using answer key.
Note: Develop teaching strategies for students who did not achieve minimum criteria.
- Record student's written test grade in grade book.
- Record written test score on each student's competency profile.

Day 15

Introduction:

- Return written test and review answers.
- Discuss strategies for students who did not achieve minimum criteria on written test.
- State the objectives for today's lesson.

Delivery and Application:

- Have students complete Assignment Sheet 6.
- Discuss findings of Assignment Sheet 6.
- Turn in Assignment Sheet 6.

Closure:

- Review unit and specific objectives.
- Review next lesson.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 6 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 6 grade in grade book.
- Record appropriate competency level on each student's competency profile.
- Return Assignment Sheet 6 at next class.

Forestry Review

Name _____ Overall Rating _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate serious effort was taken in completing worksheet	_____

Introduction

The forest and forest products industries in this country make up a multibillion dollar part of our economy. Experts estimate that the forestry industry produces about 6 percent of the gross national product in the United States. Almost 5 percent of all jobs in the United States are in the forestry and forest products industries. Clearly this is a big business that you should know more about.

Directions

Answer the following questions concerning forestry. For help, refer to the information sheets in this unit. Circle the correct response for each question.

1. A complex community of associated trees, shrubs, other plants, and animals is a:
 - a. Habitat.
 - b. Forest.
 - c. Park.
 - d. Tree farm.
2. There are about _____ million acres of forests in the United States.
 - a. 250
 - b. 495
 - c. 747
 - d. 900
3. _____ percent of the U.S. forestland is referred to as commercial forest.
 - a. 40%
 - b. 67%
 - c. 50%
 - d. 33%

Review

4. Federal, state and local governments own _____% of the commercial forests.
 - a. 58%
 - b. 14%
 - c. 66%
 - d. 28%
5. An old-growth forest is:
 - a. An uncut forest.
 - b. Areas of forest that have been cut and have regrown.
 - c. A complex community of associated trees.
 - d. A single-stemmed woody plant usually over 20 feet high at maturity.
6. The foliage and flowering/fruiting part of the tree is the:
 - a. Trunk
 - b. Branch
 - c. Crown
 - d. Roots
7. Single unit of foliage that functions primarily in food manufacture through photosynthesis.
 - a. Flowers
 - b. Leaves
 - c. Buds
 - d. Phloem
8. The small bodies produced by flowering plants which are capable of developing by germination (sprouting).
 - a. Bud
 - b. Fruit
 - c. Flowers
 - d. Seeds
9. The part of the trunk that protects the tree from injuries.
 - a. Phloem
 - b. Outer bark
 - c. Cambium
 - d. Heartwood
10. The part of the trunk that carries sap from roots to leaves.
 - a. Outer bark
 - b. Xylem
 - c. Phloem
 - d. Cambium

Review

11. A type of root that grows vertically downward and anchors the tree.
 - a. Lateral
 - b. Root hair
 - c. Tap
 - d. Feeder
12. The process of producing carbohydrates from water, carbon dioxide, chlorophyll, and light.
 - a. Silviculture
 - b. Forestry
 - c. Carbohydrate conversion
 - d. Photosynthesis
13. Trees usually begin growth in the _____ when the temperature is warm enough.
 - a. Winter
 - b. Spring
 - c. Summer
 - d. Fall
14. _____ are the building blocks of trees.
 - a. Roots
 - b. Branches
 - c. Leaves
 - d. Cells
15. New growth from under the bark forms the _____.
 - a. Biannual ring
 - b. Annual ring
 - c. Semiannual ring
 - d. Wedding ring
16. Plants that shed their leaves at the end of the growing season and remain leafless during the dormant (non-growing) season.
 - a. Conifer
 - b. Evergreen
 - c. Softwood
 - d. Deciduous

Review

17. A common use of trees is for shade. Shade _____.
a. Shields us from the sun.
b. Shields us from undesirable winds.
c. Shields us from undesirable views or noises.
d. Is used for beauty in a landscape.
18. A benefit of forests to the environment.
a. Provides carbon dioxide to the atmosphere.
b. Increase floods.
c. Provides habitats for fish and wildlife.
d. Increases water erosion.
19. A government agency that provides resources to forest owners.
a. Environmental Protection Agency
b. OSHA
c. U.S. Forest Service
d. U.S. Department of Treasury
20. _____ — the major forest region that covers the states of California, Oregon, Washington, and Alaska.
a. Rocky Mountain (Western)
b. Northern
c. Central Hardwood
d. Pacific Coast and Northwest
21. Clear cutting:
a. Removing trees killed or damaged by fire, ice, storms, or natural catastrophes.
b. Removing trees damaged by diseases or insects.
c. All the trees in a stand are harvested in a single operation.
d. Removing surplus trees, thereby, reducing competition and improving the growth and quality of the remaining trees.
22. A board foot is:
a. A stack of wood 4 feet by 4 feet by 8 feet or 128 cubic feet.
b. Refers to the number of boards of a specific dimension.
c. Rough wood cube one foot on each side.
d. Rough wood one foot square and one inch thick.

Review

-
- | | |
|--|---|
| | <p>23. A tree scale (Biltmore) stick is used to:</p> <ul style="list-style-type: none">a. Extract cores from trees for the determination of growth and age.b. Measure tree diameter and tree height.c. Directly measure the diameter of a tree.d. Determine horizontal distances. <p>24. A type of forest fire that burns the organic materials beneath the surface litter is called a:</p> <ul style="list-style-type: none">a. Wildfireb. Crown firec. Surface fired. Ground fire <p>25. A benefit of a controlled burn.</p> <ul style="list-style-type: none">a. Increases the hazard of wildfire.b. Decreases nutrient levels in forage.c. Makes access to the forest harder.d. Removes undesirable trees and brush. |
|--|---|

Forestry Review—Answer Key

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate serious effort was taken in completing worksheet	_____

Introduction

The forest and forest products industries in this country make up a multibillion dollar part of our economy. Experts estimate that the forestry industry produces about 6 percent of the gross national product in the United States. Almost 5 percent of all jobs in the United States are in the forestry and forest products industries. Clearly this is a big business that you should know more about.

Directions

Answer the following questions concerning forestry. For help, refer to the information sheets in this unit. Circle the correct response for each question.

1. A complex community of associated trees, shrubs, other plants, and animals is a:
 - a. Habitat.
 - b. Forest.**
 - c. Park.
 - d. Tree farm.
2. There are about _____ million acres of forests in the United States.
 - a. 250
 - b. 495
 - c. 747**
 - d. 900
3. _____ percent of the U.S. forestland is referred to as commercial forest.
 - a. 40%
 - b. 67%**
 - c. 50%
 - d. 33%

Review—Answer Key

4. Federal, state and local governments own _____% of the commercial forests.
 - a. 58%
 - b. 14%
 - c. 66%
 - d. **28%**
5. An old-growth forest is:
 - a. **An uncut forest.**
 - b. Areas of forest that have been cut and have regrown.
 - c. A complex community of associated trees.
 - d. A single-stemmed woody plant usually over 20 feet high at maturity.
6. The foliage and flowering/fruiting part of the tree is the:
 - a. Trunk
 - b. Branch
 - c. **Crown**
 - d. Roots
7. Single unit of foliage that functions primarily in food manufacture through photosynthesis.
 - a. Flowers
 - b. **Leaves**
 - c. Buds
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8. The small bodies produced by flowering plants which are capable of developing by germination (sprouting).
 - a. Bud
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 - d. **Seeds**
9. The part of the trunk that protects the tree from injuries.
 - a. Phloem
 - b. **Outer bark**
 - c. Cambium
 - d. Heartwood
10. The part of the trunk that carries sap from roots to leaves.
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Review—Answer Key

11. A type of root that grows vertically downward and anchors the tree.
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 - b. Root hair
 - c. Tap**
 - d. Feeder
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 - b. Forestry
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13. Trees usually begin growth in the _____ when the temperature is warm enough.
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 - b. Spring**
 - c. Summer
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14. _____ are the building blocks of trees.
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15. New growth from under the bark forms the _____.
 - a. Biannual ring
 - b. Annual ring**
 - c. Semiannual ring
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16. Plants that shed their leaves at the end of the growing season and remain leafless during the dormant (non-growing) season.
 - a. Conifer
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 - c. Softwood
 - d. Deciduous**

Review—Answer Key

17. A common use of trees is for shade. Shade _____.
a. **Shields us from the sun.**
b. Shields us from undesirable winds.
c. Shields us from undesirable views or noises.
d. Is used for beauty in a landscape.
18. A benefit of forests to the environment.
a. Provides carbon dioxide to the atmosphere.
b. Increase floods.
c. **Provides habitats for fish and wildlife.**
d. Increases water erosion.
19. A government agency that provides resources to forest owners.
a. Environmental Protection Agency
b. OSHA
c. **U.S. Forest Service**
d. U.S. Department of Treasury
20. _____ — the major forest region that covers the states of California, Oregon, Washington, and Alaska.
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b. Northern
c. Central Hardwood
d. **Pacific Coast and Northwest**
21. Clear cutting:
a. Removing trees killed or damaged by fire, ice, storms, or natural catastrophes.
b. Removing trees damaged by diseases or insects.
c. **All the trees in a stand are harvested in a single operation.**
d. Removing surplus trees, thereby, reducing competition and improving the growth and quality of the remaining trees.
22. A board foot is:
a. A stack of wood 4 feet by 4 feet by 8 feet or 128 cubic feet.
b. Refers to the number of boards of a specific dimension.
c. Rough wood cube one foot on each side.
d. **Rough wood one foot square and one inch thick.**

Review—Answer Key

23. A tree scale (Biltmore) stick is used to:
- a. Extract cores from trees for the determination of growth and age.
 - b. Measure tree diameter and tree height.**
 - c. Directly measure the diameter of a tree.
 - d. Determine horizontal distances.
24. A type of forest fire that burns the organic materials beneath the surface litter is called a:
- a. Wildfire
 - b. Crown fire
 - c. Surface fire
 - d. Ground fire**
25. A benefit of a controlled burn.
- a. Increases the hazard of wildfire.
 - b. Decreases nutrient levels in forage.
 - c. Makes access to the forest harder.
 - d. Removes undesirable trees and brush.**

Answers to Assignment Sheets**Assignment
Sheet 1****Identify Specific Trees**

Student performance should be evaluated according to the criteria listed on the assignment sheet.

**Assignment
Sheet 2****Determine the Age of a Tree**

Student performance should be evaluated according to the criteria listed on the assignment sheet.

**Assignment
Sheet 3****Determine Uses of Wood and Wood By-Products**

Student performance should be evaluated according to the criteria listed on the assignment sheet.

**Assignment
Sheet 4****Solve Cord Measurement Problems**

See answer key.

**Assignment
Sheet 5****Analyze Areas of Conflict in Maintaining Forests and Urban Trees**

Student performance should be evaluated according to the criteria listed on the assignment sheet.

**Assignment
Sheet 6****Analyze Current Reports Concerning Areas of Conflict in Forestry**

Student performance should be evaluated according to the criteria listed on the assignment sheet.

Assignment Sheet 4—Solve Cord Measurement Problems—Answer Key

Evaluation Criteria	Rating
• Answers are correct	_____
• Assignment was completed on time	_____

Introduction

This exercise is aimed at developing math skills using volumetric measures of wood—the cord.

Directions

Using the formulas provided, solve the following cord measurement problems by placing the answers in the spaces provided. Show your work.

- | | |
|-----------------------------|-----------------------------|
| a. $2 \times 4 \times 6 =$ | f. $4 \times 6 \times 8 =$ |
| b. $2 \times 4 \times 8 =$ | g. $2 \times 8 \times 8 =$ |
| c. $4 \times 4 \times 6 =$ | h. $4 \times 4 \times 20 =$ |
| d. $4 \times 4 \times 4 =$ | i. $2 \times 6 \times 10 =$ |
| e. $2 \times 2 \times 20 =$ | j. $8 \times 8 \times 10 =$ |

1. Length x width x height = _____ cubic feet

- | | |
|--------------|---------------|
| a. <u>48</u> | f. <u>192</u> |
| b. <u>64</u> | g. <u>128</u> |
| c. <u>96</u> | h. <u>320</u> |
| d. <u>64</u> | i. <u>120</u> |
| e. <u>80</u> | j. <u>640</u> |

Assignment Sheet 4—Answer Key

2. Cubic feet/128 = _____ % of a cord

- | | |
|----------------|-----------------|
| a. <u>37.5</u> | f. <u>150</u> |
| b. <u>50</u> | g. <u>100</u> |
| c. <u>75</u> | h. <u>250</u> |
| d. <u>50</u> | i. <u>93.75</u> |
| e. <u>62.5</u> | j. <u>500</u> |

3. Percent of a cord x cost of cord = _____ cost of a pile of wood

Note: Assume the cost of a cord for this problem if \$70.00. Round answers to nearest cents.

- | | |
|-------------------|--------------------|
| a. <u>\$26.25</u> | f. <u>\$105.00</u> |
| b. <u>\$35.00</u> | g. <u>\$70.00</u> |
| c. <u>\$52.50</u> | h. <u>\$175.00</u> |
| d. <u>\$35.00</u> | i. <u>\$65.63</u> |
| e. <u>\$43.75</u> | j. <u>\$350.00</u> |

Written Test

Name _____

Date _____ Score _____

Objective 1

Match terms related to forestry with their definitions. Write the corresponding numbers on the blanks provided.

- | | | |
|----------------|----------------------|-----------------|
| 1. Chlorophyll | 5. Forestry | 9. Silviculture |
| 2. Conifer | 6. Old-growth Forest | 10. Tree |
| 3. Deciduous | 7. Photosynthesis | |
| 4. Forest | 8. Regrowth Forest | |

- _____ a. A complex community of associated trees, shrubs, other plants, and animals
- _____ b. Areas of forest that have been cut and have regrown
- _____ c. The art and science of managing forests so as to yield, on a continuous basis, a maximum in quality and quantity of forest lands to satisfy human needs
- _____ d. Trees that bear seeds in cones and that have long, narrow (needlelike) leaves
- _____ e. An uncut forest
- _____ f. The art of producing and caring for a forest
- _____ g. The process of producing carbohydrates from water, carbon dioxide, chlorophyll, and light
- _____ h. A single-stemmed woody plant usually over 20 feet high at maturity
- _____ i. Green photosynthetic coloring matter in plants
- _____ j. Plants that shed all their leaves at the end of the growing season and remain leafless during the dormant (non-growing) season

Written Test

Objective 2

Select true statements related to forestry by placing an "X" in the blanks next to the true statements.

- ☐ a. There are about 9.8 billion acres of forests worldwide.
- ☐ b. Two-thirds (67%) of the U.S. forest and woodlands are non-commercial forestland.
- ☐ c. Individuals own 56% of the commercial forests.
- ☐ d. There are 747 million acres of forests in the United States.

Objective 3

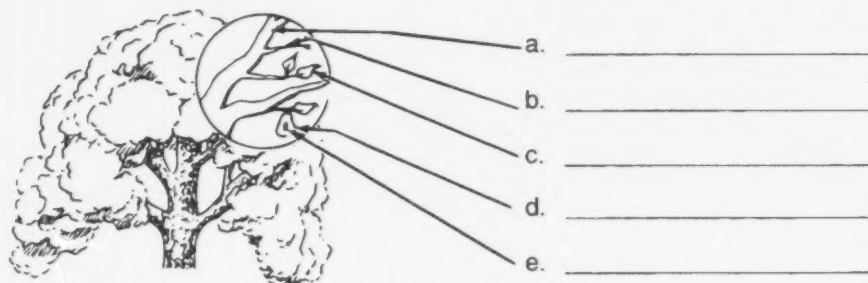
Distinguish among the main parts of a tree by placing the following letter next to the correct descriptions:

- C—Crown
- R—Roots
- T—Trunk

- ☐ a. The main stem of the tree that transports nutrients
- ☐ b. The foliage and flowering/fruiting part of the tree
- ☐ c. The underground part of the tree that extracts nutrients from the soil and atmosphere

Objective 4

Identify the following parts of the crown. Write your answers in the blanks provided.



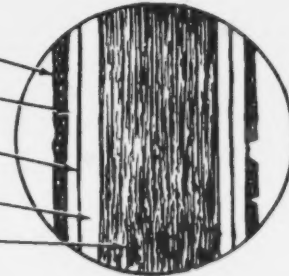
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Written Test

Objective 5

Identify the following parts of the trunk. Write your answers in the blanks provided.

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____



Objective 6

Distinguish among types of roots in a root system by placing the following letter next to the correct descriptions:

- F—Feeder roots and root hairs
- L—Lateral roots
- T—Tap roots

- _____ a. Grow vertically downward and anchor the tree
- _____ b. Grow horizontally and help keep the tree upright
- _____ c. Absorb water and minerals

Objective 7

Select from the following list ways trees are identified by placing an "X" in the blanks next to the true statements.

- _____ a. Leaves
- _____ b. Roots
- _____ c. Flowers
- _____ d. Bark
- _____ e. Overall form
- _____ f. Fruits

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Written Test

Objective 8

Select true statements concerning the photosynthesis process by placing an "X" in the blanks next to the true statements.

- _____ a. Sugars and starches are carbohydrates.
- _____ b. Fats and proteins may be used for tree growth or respiration.
- _____ c. The by-product of photosynthesis is carbon monoxide.
- _____ d. Photosynthesis may occur in the dark.
- _____ e. Fats and proteins may be stored by the tree.

Objective 9

Complete following statements concerning the growth of trees by circling or underlining the correct answers.

- a. Trees begin growth in the (spring) (summer) when the temperature is warm enough.
- b. Growth is (faster) (slower) in the summer because of the hot, dry weather.
- c. Root tips, twigs, and (flowers) (branches) increase in length when cells become longer.
- d. One annual ring is produced each (season) (year).
- e. The (age) (type) of tree can be determined by counting the number of rings.

Objective 10

Distinguish between the classifications of trees by placing a "H" for hardwood and a "S" for softwood in the blanks next to the correct description.

- _____ a. Wood produced by deciduous (broadleaf) trees.
- _____ b. Wood produced by conifers.

Objective 11

Select from the following list common uses of trees by placing an "X" in the blanks next to the true statements.

- _____ a. Timber production
- _____ b. Shade
- _____ c. Windbreaks
- _____ d. Fruit and nut production
- _____ e. Ornamental use

Written Test

Objective 12

Select from the following list the benefits of forests to the environment by placing an "X" in the blanks next to the true statements.

- ☐ a. Influence the climate
- ☐ b. Control water erosion
- ☐ c. Retain snowmelts
- ☐ d. Provide habitats for fish and wildlife
- ☐ e. Encourage floods
- ☐ f. Increase wind erosion
- ☐ g. Increase pollutants to the environment
- ☐ h. Provide oxygen to the atmosphere

Objective 13

List three government agencies involved in forestry.

- a. _____
- b. _____
- c. _____

Written Test

Objective 14

Identify the major forest regions of the United States. Write your answers in the blanks provided.



- a. _____
- b. _____
- c. _____
- d. _____
- e. _____
- f. _____

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Written Test

Objective 15

Match the types of forest cuttings with their definitions. Write the corresponding numbers on the blanks provided.

- | | |
|------------------------|-----------------------|
| 1. Clear cutting | 5. Salvage cutting |
| 2. Harvest cutting | 6. Sanitation cutting |
| 3. Improvement cutting | 7. Selective cutting |
| 4. Release cutting | 8. Thinning |

- _____ a. Removing trees damaged by diseases or insects
- _____ b. Removing surplus trees
- _____ c. Used to regulate species composition or improve the growth and quality of a young stand up to sapling size
- _____ d. All the trees in a stand are harvested in a single operation
- _____ e. Removing financially or physically mature trees for timber
- _____ f. Individual marketable trees are selected and cut

Objective 16

List two ways that tree stands regenerate

- a. _____
- b. _____

Objective 17

Match the forest measurements with their descriptions. Write the corresponding numbers on the blanks provided.

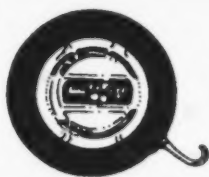
- | | | |
|--------------|--------------|-----------|
| 1. Board ft. | 3. Cubic ft. | 5. Piece |
| 2. Cord | 4. Diameter | 6. Weight |

- _____ a. Rough wood one foot on each side; contains 12 board feet
- _____ b. Used commonly in the pulp and paper industry
- _____ c. Rough wood one foot square and one inch thick
- _____ d. The distance across a tree at 4.5 feet above the ground
- _____ e. A stack of wood 4 ft. x 4 ft. x 8 ft. or 128 cu. ft.

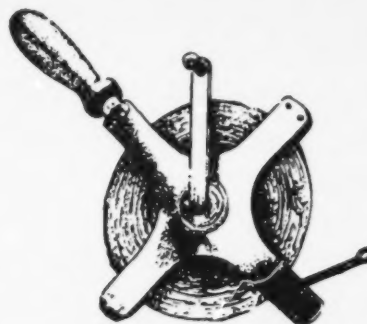
Written Test

Objective 18

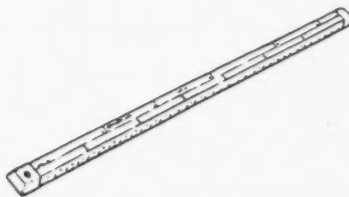
Identify the following measuring instruments used in forestry. Write your answers in the blanks provided.



a. _____



b. _____



c. _____



d. _____

Objective 19

List three forest (tree) enemies.

a. _____

b. _____

c. _____

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Written Test

Objective 20

Select from the following list causes of fire. Place an "X" in the blanks next to the correct ways.

- _____ a. Arson
- _____ b. Backfire from a car
- _____ c. Railroads
- _____ d. Debris burning
- _____ e. Cigarettes, cigars, pipes

Objective 21

Match the terms with their definitions. Write the corresponding numbers on the blanks provided. Definitions continue on the next page.

- | | |
|-----------------|------------------|
| 1. Crown fires | 3. Surface fires |
| 2. Ground fires | 4. Wildfires |

- _____ a. Burn surface litter
- _____ b. Burn from top to top of trees or shrubs
- _____ c. Burn the organic matter beneath the surface litter

Objective 22

Distinguish between the categories of forest fires by placing an "X" in the blanks next to the true statements.

- _____ a. Fires burning out of control
- _____ b. Any burning that has been started intentionally as a forest management tool

Objective 23

Select from the following list benefits of controlled burns by placing an "X" in the blanks next to the true statements.

- _____ a. Increases the hazard of wildfire
- _____ b. Makes access to the forest harder
- _____ c. Controls forest diseases
- _____ d. Increase undesirable trees and brush
- _____ e. Stimulates sprouts and seedlings

Written Test

Objective 24

List three career opportunities related to forestry.

- a. _____
- b. _____
- c. _____

*Permission to duplicate this test is granted.

Written Test—Answer Key

Objective 1

Match terms related to forestry with their definitions. Write the corresponding numbers on the blanks provided.

- | | | |
|----------------|----------------------|-----------------|
| 1. Chlorophyll | 5. Forestry | 9. Silviculture |
| 2. Conifer | 6. Old-growth Forest | 10. Tree |
| 3. Deciduous | 7. Photosynthesis | |
| 4. Forest | 8. Regrowth Forest | |

- 4 a. A complex community of associated trees, shrubs, other plants, and animals
- 8 b. Areas of forest that have been cut and have regrown
- 5 c. The art and science of managing forests so as to yield, on a continuous basis, a maximum in quality and quantity of forest lands to satisfy human needs
- 2 d. Trees that bear seeds in cones and that have long, narrow (needlelike) leaves
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- 1 i. Green photosynthetic coloring matter in plants
- 3 j. Plants that shed all their leaves at the end of the growing season and remain leafless during the dormant (non-growing) season

Written Test—Answer Key

Objective 2

Select **true** statements related to forestry by placing an "X" in the blanks next to the **true** statements.

- ☒ a. There are about 9.8 billion acres of forests worldwide.
- ☐ b. Two-thirds (67%) of the U.S. forest and woodlands are non-commercial forestland.
- ☒ c. Individuals own 56% of the commercial forests.
- ☒ d. There are 747 million acres of forests in the United States.

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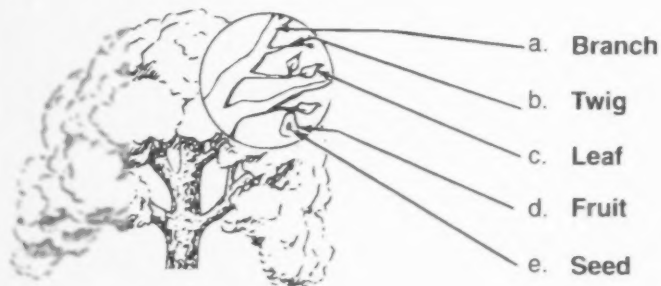
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Written Test—Answer Key

Objective 5

Identify the following parts of the trunk. Write your answers in the blanks provided.

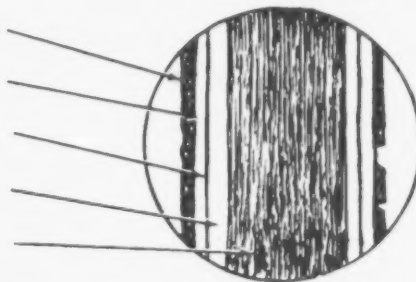
a. Outer bark

b. Phloem

c. Cambium

d. Xylem

e. Heartwood



Objective 6

Distinguish among types of roots in a root system by placing the following letter next to the correct descriptions:

- F—Feeder roots and root hairs
- L—Lateral roots
- T—Tap roots

 T a. Grow vertically downward and anchor the tree

 L b. Grow horizontally and help keep the tree upright

 F c. Absorb water and minerals

Objective 7

Select from the following list ways trees are identified by placing an "X" in the blanks next to the true statements.

 X a. Leaves

 b. Roots

 X c. Flowers

 X d. Bark

 X e. Overall form

 X f. Fruits

Written Test—Answer Key

Objective 8

Select true statements concerning the photosynthesis process by placing an "X" in the blanks next to the true statements.

- ☒ a. Sugars and starches are carbohydrates.
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- ☐ c. The by-product of photosynthesis is carbon monoxide.
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- ☒ c. Windbreaks
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Written Test—Answer Key

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Select from the following list the benefits of forests to the environment by placing an "X" in the blanks next to the true statements.

- ☒ a. Influence the climate
- ☒ b. Control water erosion
- ☒ c. Retain snowmelts
- ☒ d. Provide habitats for fish and wildlife
- ☐ e. Encourage floods
- ☐ f. Increase wind erosion
- ☐ g. Increase pollutants to the environment
- ☒ h. Provide oxygen to the atmosphere

Objective 13

List three government agencies involved in forestry.

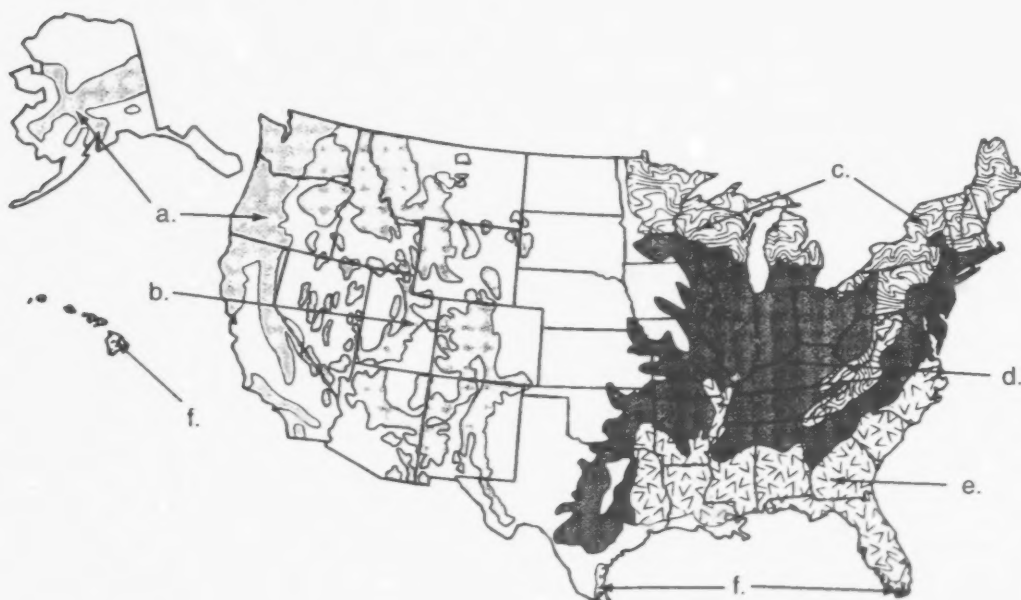
Any three of the following:

- U.S. Forest Service
- National Park Service
- Bureau of Land Management
- Bureau of Indian Affairs
- State forestry service
- City and county governments

Written Test—Answer Key

Objective 14

Identify the major forest regions of the United States. Write your answers in the blanks provided.



- a. Pacific Coast and Northwest
- b. Rocky Mountain (Western)
- c. Northern
- d. Central Hardwood
- e. Southern
- f. Tropical

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Written Test—Answer Key

Objective 15

Match the types of forest cuttings with their definitions. Write the corresponding numbers on the blanks provided.

- | | |
|------------------------|-----------------------|
| 1. Clear cutting | 5. Salvage cutting |
| 2. Harvest cutting | 6. Sanitation cutting |
| 3. Improvement cutting | 7. Selective cutting |
| 4. Release cutting | 8. Thinning |

- 6 a. Removing trees damaged by diseases or insects
- 8 b. Removing surplus trees
- 4 c. Used to regulate species composition or improve the growth and quality of a young stand up to sapling size
- 1 d. All the trees in a stand are harvested in a single operation
- 2 e. Removing financially or physically mature trees for timber
- 7 f. Individual marketable trees are selected and cut

Objective 16

List two ways that tree stands regenerate

Any two of the following

- Seeding (natural or direct)
- Stump sprouting
- Plant seedlings

Objective 17

Match the forest measurements with their descriptions. Write the corresponding numbers on the blanks provided.

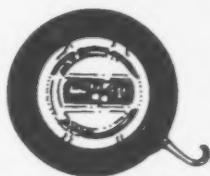
- | | | |
|--------------|--------------|-----------|
| 1. Board ft. | 3. Cubic ft. | 5. Piece |
| 2. Cord | 4. Diameter | 6. Weight |

- 3 a. Rough wood one foot on each side; contains 12 board feet
- 6 b. Used commonly in the pulp and paper industry
- 1 c. Rough wood one foot square and one inch thick
- 4 d. The distance across a tree at 4.5 feet above the ground
- 2 e. A stack of wood 4 ft. x 4 ft. x 8 ft. or 128 cu. ft.

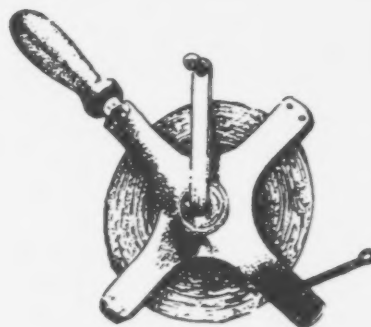
Written Test—Answer Key

Objective 18

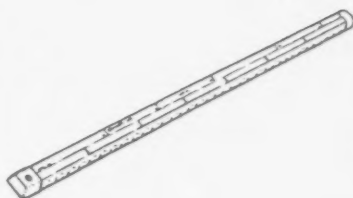
Identify the following measuring instruments used in forestry. Write your answers in the blanks provided.



a. Diameter tape



b. Chain or tape



c. Tree scale (Biltmore) stick



d. Increment borer

Objective 19

List three forest (tree) enemies.

Any three of the following:

- Insects
- Diseases
- Physical damage
- Fire

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Written Test—Answer Key

Objective 20

Select from the following list causes of fire. Place an "X" in the blanks next to the correct ways.

- ☒ a. Arson
- ☐ b. Backfire from a car
- ☒ c. Railroads
- ☒ d. Debris burning
- ☒ e. Cigarettes, cigars, pipes

Objective 21

Match the terms with their definitions. Write the corresponding numbers on the blanks provided. Definitions continue on the next page.

- | | |
|-----------------|------------------|
| 1. Crown fires | 3. Surface fires |
| 2. Ground fires | 4. Wildfires |

- 3 a. Burn surface litter
- 1 b. Burn from top to top of trees or shrubs
- 2 c. Burn the organic matter beneath the surface litter

Objective 22

Distinguish between the categories of forest fires by placing an "X" in the blanks next to the true statements.

- ☐ a. Fires burning out of control
- ☒ b. Any burning that has been started intentionally as a forest management tool

Objective 23

Select from the following list benefits of controlled burns by placing an "X" in the blanks next to the true statements.

- ☐ a. Increase the hazard of wildfire
- ☐ b. Makes access to the forest harder
- ☒ c. Controls forest diseases
- ☐ d. Increase undesirable trees and brush
- ☒ e. Stimulates sprouts and seedlings

Written Test—Answer Key

Objective 24

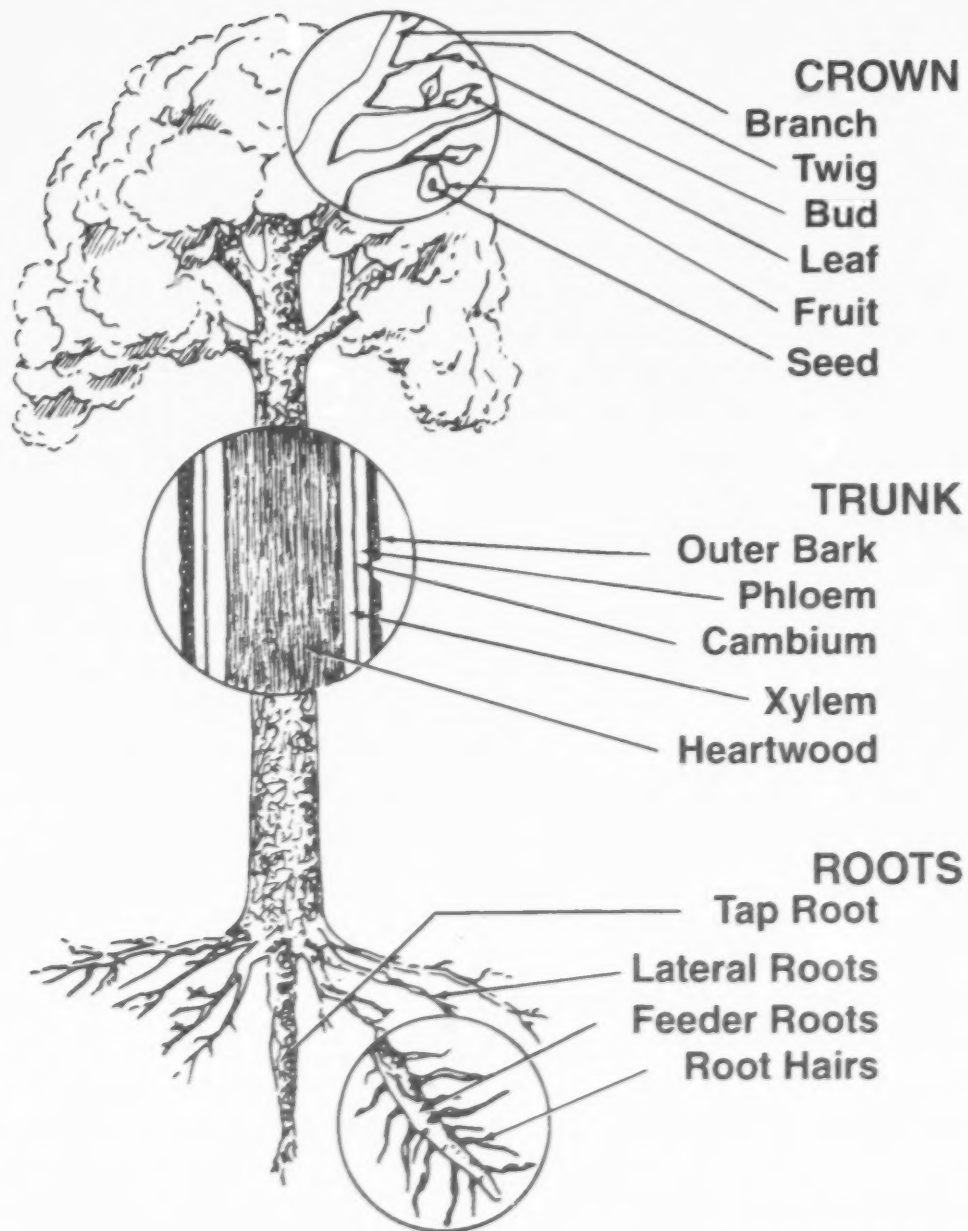
List three career opportunities related to forestry.

Any three of the following:

- Foresters
- Forestry technicians
- Loggers
- Log scalers
- Forestry researchers
- Industry representatives

*Permission to duplicate this test is granted.

Main Parts of a Tree

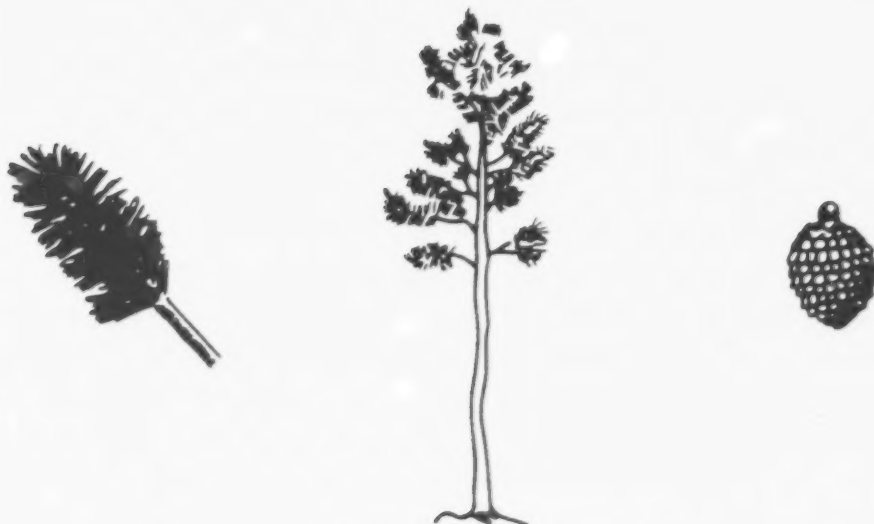


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TM 1

T 7-53

Classifications of Trees



Softwoods
From Coniferous Trees



Hardwoods
From Deciduous Trees

Forest Regions of the United States



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TM 3

T 7-57

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* Assignment Sheets are located in the Student Workbook.	

Instructional
Plan

Suggested Activities

Preparation

- Review the unit objective. Study the specific objectives to determine the order in which you will present the objectives.
- Review the suggested lesson plan. The plan identifies an order for instruction to take place. Each "day" represents a 50-minute class period. The plan is designed to cover the specific objectives over a 15-day period. Additional days and/or activities may be added. (Note: You may want to change days to specific dates. Example: Day 1 may become Monday, March 25, Day 2 = Tuesday, March 26, and so forth.) You will want to localize, supplement, and personalize the plan to fit your situation.
- Review the teaching suggestions included in this instructional plan section to plan classroom activities. Also note the suggestions for supplemental resources.
- Plan your delivery/application to take advantage of student learning styles and to accommodate special-needs students.
- Obtain various resources such as films, videotapes, and other materials to supplement instruction of this unit. See "Resources for Developing This Unit" and "Suggested Supplemental Resources" for more information.
- Make transparencies or computer presentation from the transparency masters included in this unit. These appear in the teacher edition only and should be used with objectives as indicated below.

TM 1—Food Chains (Objective 2)
TM 2—Biotic Pyramid (Objective 2)
TM 3—Food Web (Objective 3)
TM 4—Agricultural Practices That Support Wildlife (Objective 18)
- Select teacher components (written test, unit review) you want to distribute to your students. Copy and prepare these components for distribution.
- Prepare classroom. Put up posters and charts and display articles and other references related to the objectives of this unit.

Suggested Activities

Delivery and Application

- Discuss unit and specific objectives.
- Discuss information sheets. Implement teaching plan to localize, supplement, and personalize the unit. Reinforce basic academic and workplace skills when applicable.
- Discuss the assignment sheets. Review with students the criteria for evaluation of each of these activities.

Teaching Suggestions

The skill areas appearing in bold-face type in the teaching suggestions refer to the academic and workplace skills identified in *What Work Requires of Schools: A SCANS Report for America 2000* and *Workplace Basics: The Skills Employers Want*. These have been adapted by MAVCC.

- Arrange for representatives of your state's wildlife department or wildlife specialists from your state's land-grant university's Cooperative Extension Service to visit the class to discuss the need for and the practice of biology-based and/or botany-based wildlife management. **(Applying principles of biology/botany; critical thinking; listening)**
- Arrange for hunter safety and sportsmanship training for interested students and community members.
- Discuss the cause and effect of pollution on endangered species in your state. Have students divide into two groups—one arguing for more protection of our endangered species and one arguing against government regulations and controls to protect endangered species and their natural habitats—and have them debate this topic. Have them conclude the debate and discussion with the class reaching a consensus on our responsibilities as humans in the protection of these endangered species. **(Listening; speaking; critical thinking; teamwork; negotiation)**
- Provide students with examples of deer management techniques and the consequences of over-population of deer herds. (This might best be done by a wildlife professional active in enforcement of game laws and management of your state's deer herd.) Lead the class in working through a deer management project (Assignment Sheet 5.) **(Listening; speaking; critical thinking; teamwork; applying scientific principles and methods)**

Suggested Activities

- Obtain information and supplies for food plot and wildlife habitat improvement. Contact your state's wildlife department, a game ranger, and/or a Cooperative Extension Service office for materials to help complete these activities. These projects are designed to help students learn ways to improve wildlife habitats for game and non-game animals, and to increase wildlife food supplies in areas near their school or in their community. Upon completion of these activities, have students discuss what contributions they have made to wildlife in their community. (**Reading; listening; speaking; teamwork; problem solving; applying scientific principles and methods**)
- Develop a wildlife food plot:
 1. Select a game or non-game animal in your local area and determine its habitat and nutritional needs.
 2. Develop a food plot for the selected animal.
 3. Obtain seeds or seedlings and plant them at the proper time to ensure survival.
 4. Observe the plot over time to determine if the food plot is actually attracting the chosen animal.
- Develop a wildlife habitat
 1. Select a game or non-game animal in your local area and determine its habitat and nutritional needs.
 2. Develop a plan to improve habitat potential (bird houses, nesting facilities, evergreen tree cover, artificial reefs for fish, etc.) for the selected animal.
 3. Obtain plans for any construction needed.
 4. Use professional information concerning placement and design of wildlife habitat improvements for the selected animal.
 5. Obtain seeds or seedlings.
 6. Plant or install the necessary additions in an area suitable for the selected animal to live.
 7. Observe the area over time to determine if the improvements have truly improved the habitat availability for the selected animal.
 8. Write a report detailing the entire project from its inception to its overall success.

Evaluation

- Give and evaluate Wildlife Management Review.
- Copy written test and give to students as pretest.
- Evaluate assignment sheets. See the evaluation criteria listed at the top of each assignment sheet. Evaluation may be localized, personalized, or individualized to fit your situation. Record student's grade in your grade book.

Suggested Activities

- Give and evaluate written test. Record student's written test score in your grade book and on the student's competency profile.
- Measure competency gains by comparing written pretest scores with posttest scores.
- Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas of improvement.
- Reteach and retest as required.

Instructions for Evaluating Student Performance

- When the student is ready to perform a specific task, obtain a copy of the assignment sheet which may be found in the student workbook.
- Once the student has completed an assignment sheet, evaluate the student's work using the evaluation criteria. If the student's work is unsatisfactory, have the student review the assignment sheet and submit their work for evaluation again. Record the appropriate level of competency on the student's competency profile.
- Sample performance evaluation keys have been provided below. Many other keys are available. Select one rating (grading scale) which best fits your program needs.

Sample A

- 4—**Skilled**—Can perform job with no additional training.
- 3—**Moderately skilled**—Has performed job during training program; limited additional training may be required.
- 2—**Limited skill**—Has performed job during training program; additional training is required to develop skill.
- 1—**Unskilled**—Is familiar with process, but is unable to perform job.
- 0—**No exposure**—No information or practice provided during training program.

Sample B

- Yes**—Can perform job with no additional training.
- No**—Is unable to perform job satisfactorily.

- Give and evaluate the posttest.
- Meet individually with students to evaluate their progress through this unit of instruction and indicate to them possible areas of improvement.
- Reteach and retest as required.
- Encourage students to continue their portfolio. The portfolio should become a record of the student's progress in the study of natural resources.

Suggested Activities

Resources Used in Developing This Unit

Note: URLs change frequently. Any of the web sites listed may have moved.

- Camp, William G. and Thomas B. Daugherty. *Managing Our Natural Resources (4th Edition)*. Albany, NY: Delmar Publishers Inc., 2002.
www.agriscience.delmar.com
- Lee, Jasper S., *Natural Resources and Environmental Technology*, Danville, IL: Interstate Publishers, Inc., 2000.
www.interstatepublishers.com
- Porter, Lynn, Jasper S. Lee, Diana L. Turner, and Malcolm Hillian, *Environmental Science and Technology (2nd edition)*, Danville, IL: Interstate Publishers, Inc., 2003.
www.interstatepublishers.com
- Stutzenbaker, Charles D., Brenda J. Scheil, Michael K. Swan, Jasper S. Lee, and Jeri Mattics Omernik, *Wildlife Management Science and Technology (2nd Edition)*, Danville, IL: Interstate Publishers, Inc., 2003.
www.interstatepublishers.com

Note: This text has useful appendixes for identifying common species of wildlife including common and scientific names and description/size. Appendixes include: Common Species of Mammal Wildlife; Examples of Bird Species Found in North America; Examples of Reptiles Found in North America; Examples of Amphibians Found in North America; and Examples of Fish Found in North America.

Suggested Supplemental Resources

- Wernert, Susan J. *Reader's Digest North American Wildlife (updated edition)*. Pleasantville, NY: Reader's Digest, 1998. An illustrated guide to 2,000 plants and animals. Available from www.amazon.com
- *Backyard Bird Identification Guide*, Pondarama.com, 2002. A complete listing with illustrations of different bird species including identification clues. Softcover 64 pages. Available from Pondarama.com, an online superstore. Phone: 877-606-POND (toll free) or www.pondarama.com
- Cadieux, Charles. *These Are The Endangered*. Washington, DC: The Stone Wall Press, Inc., 1981.
- *Wildlife Identification Pocket Guide*. Seattle, WA: Outdoor Empire Publishing, Inc., 2000. 118 pages.

Suggested Activities

- Instructional Materials Service
Cornell University
Kennedy Hall
Ithaca, NY 14853
(607) 255-9252
www.cornell.edu/dept/education/projects/IMS/ims.html

Non-profit agency of Department of Education, Cornell University. IMS's mission is to develop and supply instructional materials related to study of science and agriculture. All materials are available on a cost recovery basis. Categories in IMS Catalog include: Agri-science Curriculum; Animal Science Materials; Economic and Business Management Materials; General Interest Materials; Mechanization and Engineering Materials; Natural Resource Materials; Plant Science Materials; and Research Materials.

Selected resources:

- *Bird and Mammal Wall Charts*. Two sets of full-color, 20" X 30" wall charts showing various birds and mammals.
- *Wildlife Notes on 38 Mammals and Birds*. Pamphlets on 38 common wildlife species.
- *Agri-Quiz: Wildlife Conservation* (IBM). Contains approximately 300 T-F and multiple choice questions related to wildlife conservation. Questions can be studied at the computer or used selectively to print a quiz or major test.

- The Wildlife Society
5410 Grosvenor Lane, Suite #200
Bethesda, MD 20814
Phone: 301-8979770
www.wildlife.org

TWS is a non-profit scientific and educational association dedicated to excellence in wildlife stewardship through science and education. TWS's mission is to enhance the ability of wildlife professionals to conserve diversity, sustain productivity, and ensure responsible use of wildlife resources for the benefit of society.

Suggested Activities

- Project WILD National Office
5555 Morningside Drive, Suite 212
Houston, TX 77005
Phone: 713-520-1936
www.projectwild.org

Project WILD is a joint project of the Council for Environmental Education and the Western Association of Fish and Wildlife Agencies. The activities found in Project WILD are intended for use in both classroom and informal settings. Instructional materials such as The Project WILD Aquatic and K-12 Curriculum and Activity Guides are designed to support state and national academic standards appropriate for grades K-12.

- National Marine Fisheries Service
1315 East-West Highway
Silver Spring, MD 20910
Phone: 301-713-2328
www.st.nmfs.gov

Site describes programs, provides access to key databases (commercial fisheries landings, foreign trade, marine recreational fisheries catch and effort), and contains relevant links and references. Supports the science-based stewardship of the nation's living marine resources.

- Native American Fish and Wildlife Society
750 Burbank Street
Broomfield, CO 80020
Phone: 303-466-1725
www.nafws.org

A non-profit organization developed to assist Native American and Alaska Native Tribes with the conservation, protection, and enhancement of their fish and wildlife resources. Check out NAFWS summer youth program for Native American youth.

- USDA Natural Resources Conservation Service
www.nrcs.usda.gov

The NRCS provides leadership in a partnership effort with private landowners to help people conserve, maintain, and improve our natural resources and environment. Possible resources related to wildlife include: Wildlife Habitat Incentive Program; Wetlands Reserve Program; Conservation Reserve Program; and Wildlife Biology - Wildlife Habitat Management and Aquatic Ecology.

Suggested Activities

- U.S. Fish and Wildlife Service
www.fws.gov

The principal federal agency within the Department of Interior responsible with protecting and enhancing the populations and habitats of wildlife in the United States. The U.S. FWS's mission is, working with others, to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American People. Possible resources include:

- List of threatened or endangered species. Animals (38 pages) and plants (18 pages) are available in pdf.files (Adobe Acrobat Reader files)
- National Image Library contains the U.S. FWS's online collection of public domain still photographs.
<http://images.fws.gov>
- Ottawa National Wildlife Refuge, Oak Harbor, OH has a bird identification quiz and a wildlife and refuge quiz. Site also allows you to design a habitat management plan for the Ottawa refuge.
www.fws.gov/ottawa/quiz/manghome.html or (home page)
<http://midwest.fws.gov/ottawa/ottawa.html>
- Educator's link—www.fws.gov/educator

- National Park Service
www.nps.gov

Possible resources:

- Nature Net: nature and science in the national parks
www.nature.nps.gov
- Info Zone: service wide information

Suggested Lesson Plan**Day 1****Introduction:**

- Discuss unit objective and review specific objectives and plan for completing this unit.
- Have students read the introduction and discuss their viewpoints toward wildlife management.
- Point out to students that this unit is primarily about animal wildlife (biologist's point of view).
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 2—Food chain.
- Use TM 2 to illustrate the biotic pyramid.
- Use TM 1 to illustrate food chains.
- Assign Assignment Sheet 1—Explain Effects on a Food Chain When Parts Are Removed.
 - Discuss introduction and directions.
 - Review evaluation criteria.
 - Due date: beginning of next class.
- Have supervised study to complete Assignment Sheet 1.

Closure:

- Review introduction and Objective 2.
- Remind students the Assignment Sheet 1 is due at next class.

Evaluation:

- Non-applicable.

Day 2**Introduction:**

- Review progress on Assignment Sheet 1.
- Have students turn in Assignment Sheet 1.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 3—Interconnection in a food web.
- Use TM 3 to illustrate a food web.
- Assign Assignment Sheet 2—Create a Food Web.
 - Discuss introduction and directions.
 - Review evaluation criteria.
 - Assign due date for Day 5.
- Discuss Objective 4—Predator/prey relationship.

Closure:

- Review Objective 3.
- Review Assignment Sheet 2.

Suggested Lesson Plan

Day 3

Evaluation:

- Evaluate each student's performance on Assignment Sheet 1 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 1 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Introduction:

- Return Assignment Sheet 1. Discuss, if necessary.
- Review progress on Assignment Sheet 2.
- Review Objective 4.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 5—History of wildlife in the United States.
- Discuss Objective 6—Selected federal legislation concerning wildlife.
- Discuss Objective 7—Vertebrate and invertebrate wildlife.
- Discuss Objective 8—Characteristics of a mammal.
- Discuss Objective 9—Common mammals.

Closure:

- Review Objectives 5 and 6.
- Remind students of Assignment Sheet 2 due date.

Evaluation:

- Non-applicable.

Day 4

Introduction:

- Review progress on Assignment Sheet 2.
- Review Objectives 7, 8, and 9.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 10—Characteristics of fish wildlife.
- Discuss Objective 11—Characteristics of birds.
- Discuss Objective 12—Major types of birds.
- Discuss Objective 13—Characteristics of reptiles.
- Discuss Objective 14—Characteristics of amphibians.

Closure:

- Review Objective 10.
- Remind students that Assignment Sheet 2 is due at next class.

Evaluation:

- Non-applicable.

Suggested Lesson Plan

Day 5

Introduction:

- Have students discuss and display their findings from Assignment Sheet 2.
- Turn in Assignment Sheet 2.
- Review Objectives 11, 12, 13, and 14.
- State the objectives for today's lesson.

Delivery and Application:

- Assign Assignment Sheet 3—Identify Wildlife You See in a Certain Time Span.
 - Discuss introduction.
 - Discuss suggestions for successful completion of this assignment.
 - Discuss directions.
 - Review evaluation criteria.
 - Assign due date for Day 10.
- Discuss with students possible local areas inhabited by wildlife.
- Assist students in obtaining wildlife literature and identification guides.

Closure:

- Review Assignment Sheet 3.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 2 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 2 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Day 6

Introduction:

- Return Assignment Sheet 2. Discuss, if necessary.
- Review progress on Assignment Sheet 3.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 16—Classifications of wildlife that need protection.
- Discuss Objective 17—Dangers to wildlife populations.
- Discuss Objective 18—Agricultural practices that support wildlife.
- Use TM 4 to illustrate agricultural practices that support wildlife.
- Discuss Objective 19—Wildlife activities that may cause damage to agriculture.

Closure:

- Review Objectives 16 and 17.
- Remind students of Assignment Sheet 3 due date.

Evaluation:

- Non-applicable.

Suggested Lesson Plan

Day 7

Introduction:

- Review progress on Assignment Sheet 3.
- Review Objectives 18 and 19.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 20—Ways to control wildlife damage problems.
- Discuss Objective 21—Public wildlife and private lands.
- Discuss Objective 22—Types of private wildlife production areas.
- Discuss Objective 23—Government agencies involved in wildlife management.

Closure:

- Review Objectives 20 and 21.
- Remind students of Assignment Sheet 3 due date.

Evaluation:

- Non-applicable.

Day 8

Introduction:

- Review progress on Assignment Sheet 3.
- Review Objectives 22 and 23.
- State the objectives for today's lesson

Delivery and Application:

- Assign Assignment Sheet 4—Compile a Profile of a Wildlife Species.
 - Discuss introduction and directions.
 - Review evaluation criteria.
 - Assignment due date of Day 11.
- Have supervised study for completion of Assignment Sheet 3 and research on Assignment Sheet 4.

Closure:

- Remind students of due dates for Assignment Sheets 3 and 4.

Evaluation:

- Non-applicable.

Day 9

Introduction:

- Review progress on Assignment Sheets 3 and 4.
- State the objectives for today's lesson.

Delivery and Application:

- Have supervised study for completion of Assignment Sheet 3 and research on Assignment Sheet 4.

Closure:

- Remind students that Assignment Sheet 3 is due at next class.
- Remind student of Assignment Sheet 4 due date.

Suggested Lesson Plan

Day 10

Evaluation:

- Non-applicable.

Introduction:

- Have students present their findings for Assignment Sheet 3.
- Turn in Assignment Sheet 3.
- Review progress on Assignment Sheet 4.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 24—Career opportunities related to wildlife management.
- Have supervised study to completion of Assignment Sheet 4.

Closure:

- Review Objective 24.
- Remind students that Assignment Sheet 4 is due at next class.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 3 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 3 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Day 11

Introduction:

- Return Assignment Sheet 3. Discuss, if necessary.
- Have students discuss their wildlife profile for Assignment Sheet 4.
- Turn in Assignment Sheet 4.
- State the objectives for today's lesson.

Delivery and Application:

- Assign Assignment Sheet 6—Analyze Current Reports Concerning Wildlife Management.
 - Discuss introduction and directions.
 - Review evaluation criteria.
 - Assign due date for Day 15.
- Have supervised study to research Assignment Sheet 6.

Closure:

- Review Assignment Sheet 6.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 4 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 4 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Suggested Lesson Plan

Day 12

Introduction:

- Return Assignment Sheet 4. Discuss, if necessary.
- Review progress on Assignment 6.
- State the objectives for today's lesson.

Delivery and Application:

- Assign Assignment Sheet 5—Make Management Decisions Concerning a Deer Herd to be completed in this class.
 - Determine team members.
 - Discuss introduction and directions.
- Have students complete Assignment Sheet 5 and turn in at end of class.

Closure:

- Remind students that Wildlife Management Review will be completed in next class.
- Remind students of written test on Day 14.
- Remind students of Assignment Sheet 6 due date.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 5 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 5 grade in grade book.
- Record appropriate competency level on each student's competency profile.

Day 13

Introduction:

- Return Assignment Sheet 5. Have team members discuss their plans.
- Review progress on Assignment Sheet 6.
- State the objectives for today's lesson

Delivery and Application:

- Complete Wildlife Management Review and turn in.
- Have supervised study for research on Assignment Sheet 6 or review for written test.

Closure:

- Remind students of written test at next class.
- Remind student of Assignment Sheet 6 due date.

Evaluation:

- Evaluate each student's performance on Wildlife Management Review according to criteria stated.
- Record student's unit review grade in grade book.

Suggested Lesson Plan

Day 14

Introduction:

- Return Wildlife Management Review. Discuss, if necessary.
- Review for written test.
- State the objectives for today's lesson.

Delivery and Application:

- Give written test.
- Have students that have completed written test work on Assignment Sheet 6.

Closure:

- Review expectations for Assignment Sheet 6.

Evaluation:

- Evaluate student performance on written test using answer key.
(Note: Develop teaching strategies for students who did not achieve minimum criteria.)
- Record written test grade in grade book.
- Record written test score on each student's competency profile.

Day 15

Introduction:

- Return students' written tests and review answers.
- Discuss strategies for students who did not achieve minimum criteria on written test.
- State the objectives for today's lesson.

Delivery and Application:

- Have students complete Assignment Sheet 6.
- Have students discuss their conclusions for Assignment Sheet 6.
- Turn in Assignment Sheet 6.

Closure:

- Review unit objectives.
- Review next lesson.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 6 according to criteria stated on assignment sheet.
- Record student's Assignment Sheet 6 grade in grade book.
- Record appropriate competency level on each student's competency profile.
- Return Assignment Sheet 5 at next class.

Wildlife Management Review

Name _____ Overall Rating _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate serious effort was taken in completing worksheet	_____

Introduction

Of the many resources that are abundant in America, about half can be considered nonrenewable and the other half renewable. Wise management practices of nonrenewable resources are always stressed because once used, nonrenewable resources do not regenerate. We usually take renewable resources for granted because we have developed the attitude that there will always be more. Animals usually fall into the latter category because of the ability to reproduce, but even if they reproduce, many species have died out. It quickly becomes evident that management of our renewable resources, such as mammals, birds, and fish, is just as important as management of our coal and oil. This unit looks at the wildlife resources as well as possible management practices. We look at the future to see what can be done. We examine the past for possible mismanagement practices.

Directions

Answer the following questions concerning wildlife management. For help, refer to the information sheets in this unit. Circle the correct response for each question.

1. All plants, animals, and other living things that have not been domesticated.
 - a. Predator
 - b. Wildlife
 - c. Carnivore
 - d. Ecosystem
2. The area where an animal or plant naturally lives and grows.
 - a. Food web
 - b. Food plot
 - c. Habitat
 - d. Wildlife management

Review

3. Animals that eat plants.
 - a. Carnivores
 - b. Omnivores
 - c. Predators
 - d. Herbivores
4. On the first level of the food chain are the "_____".
 - a. producers
 - b. herbivores
 - c. carnivores
 - d. omnivores
5. A food web shows:
 - a. The area planted to maintain wildlife food supply.
 - b. The interacting system of biological community and its nonliving environment.
 - c. An arrangement of predator-prey relationship in an ecosystem.
 - d. The interconnecting food chains in an ecosystem.
6. A predator is an animal that:
 - a. Eats plants.
 - b. Hunts, kills, and consumes other animals.
 - c. Eats both plants and animals.
 - d. Is very destructive.
7. Westward expansion of settlers during the 1700's and 1800's was responsible for loss of wildlife habitat and _____.
 - a. Setting of bag limits.
 - b. Aided market hunting
 - c. Establishment of the world fur trade business.
 - d. Setting aside national parks and wildlife refuges.
8. Federal legislation that brought the federal government into the business of wildlife law enforcement.
 - a. Fish and Wildlife Conservation Act
 - b. North American Waterfowl Management Plan
 - c. Federal Aid in Wildlife Restoration Act
 - d. Lacey Act

-
9. Endangered Species Act
- a. Called for the identification of fish and wildlife not taken for sport or commercial purposes.
 - b. Provided for areas of wildlife habitat on farms near crops.
 - c. Gave authority for protecting rare and endangered species to the U.S. Fish and Wildlife Service.
 - d. Provided funding for wildlife management by placing an excise tax on firearms and ammunition.
10. An example of a vertebrate animal.
- a. Insect
 - b. Mollusk
 - c. Arachnid
 - d. Mammal
11. A characteristic of a mammal.
- a. The females give milk to their babies.
 - b. Get oxygen from water through a gill structure.
 - c. Hatch from eggs.
 - d. Body temperature adjusts to surroundings.
12. A large mammal.
- a. Lynx
 - b. Coyote
 - c. Bobcat
 - d. Deer
13. A small mammal.
- a. Sheep
 - b. Mountain goat
 - c. Beaver
 - d. Pronghorn antelope
14. A characteristic of a fish wildlife.
- a. Have the capacity to maintain a constant body temperature.
 - b. Typically live in the water in the early stages of their lives and move to land as they mature.
 - c. Body temperature adjusts to surroundings.
 - d. Have bodies covered with thick skins.

Review

15. A characteristic of a birds.
 - a. Provide milk to their young.
 - b. Have a body covered with scales or skin.
 - c. Body temperature adjusts to surroundings.
 - d. Have a body covered with feathers.
16. An upland nonmigratory bird.
 - a. Mallard duck
 - b. Sandhill crane
 - c. Quail
 - d. Eagle
17. A wetland migratory bird.
 - a. Pheasant
 - b. Canvasback duck
 - c. Hawk
 - d. Wild turkey
18. A raptor.
 - a. Grouse
 - b. Snow goose
 - c. Blue heron
 - d. Falcon
19. A common reptile.
 - a. Frog
 - b. Spider
 - c. Salamander
 - d. Turtle
20. A characteristic of amphibians.
 - a. Have paired fins and an exterior covering of scales or skin.
 - b. Typically live in water in the early stages of their lives and move to land as they mature.
 - c. Have a pair of wings and a pair of legs.
 - d. Females feed milk to their young.

21. All have four pairs of walking legs, plus two other pairs of appendages near their heads.
 - a. Insects
 - b. Crustaceans
 - c. Arachnids
 - d. Mollusks
22. An endangered species is:
 - a. A plant, animal, and other species threatened with becoming extinct. The species is not reproducing itself in sufficient numbers to assure survival.
 - b. A wildlife species that exists in small numbers. For some reason, the species may appear to be declining.
 - c. A plant, animal, or other species that faces serious dangers and is likely to become endangered.
 - d. The disappearance of living organisms from the earth. Death of the last member of the species ends the existence of a species.
23. A danger to wildlife populations.
 - a. Bag limits
 - b. Improved habitats through agriculture practices
 - c. Hunting seasons
 - d. Fires
24. An agricultural practice that supports wildlife.
 - a. Remove windbreaks to provide a better habitat for wildlife.
 - b. Drain existing wetlands to assure future wildlife habitats.
 - c. Provide food plot areas to keep wildlife away from crops.
 - d. Remove brush and dead trees.
25. A wildlife activity that may cause damage to agriculture.
 - a. Provide predator for removing unwanted prey.
 - b. Feed on agricultural crops.
 - c. Share the farm habitat with domestic animals.
 - d. Complements livestock for grass on grazing lands.
26. A way to control wildlife damage problems.
 - a. Use of fires.
 - b. Use frightening techniques.
 - c. Drain wetlands.
 - d. Remove wildlife habitat.

Review

27. More than _____ % of the game is harvested on private land.
- a. 25%
 - b. 40%
 - c. 90%
 - d. 80%
28. A type of private production area where landowners open their land in exchange for protection against random trespassing.
- a. Commercial wildlife enterprises
 - b. Preserves
 - c. Cooperatives
 - d. Farms
29. A government agency involved with wildlife management on private lands.
- a. National Park Service
 - b. Bureau of Land Management
 - c. Corps of Engineers
 - d. USDA Natural Resources Conservation Service

Wildlife Management Review—Answer Key

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate serious effort was taken in completing worksheet	_____

Introduction

Of the many resources that are abundant in America, about half can be considered nonrenewable and the other half renewable. Wise management practices of nonrenewable resources are always stressed because once used, nonrenewable resources do not regenerate. We usually take renewable resources for granted because we have developed the attitude that there will always be more. Animals usually fall into the latter category because of the ability to reproduce, but even if they reproduce, many species have died out. It quickly becomes evident that management of our renewable resources, such as mammals, birds, and fish, is just as important as management of our coal and oil. This unit looks at the wildlife resources as well as possible management practices. We look at the future to see what can be done. We examine the past for possible mismanagement practices.

Directions

Answer the following questions concerning wildlife management. For help, refer to the information sheets in this unit. Circle the correct response for each question.

1. All plants, animals, and other living things that have not been domesticated.
 - a. Predator
 - b. **Wildlife**
 - c. Carnivore
 - d. Ecosystem
2. The area where an animal or plant naturally lives and grows.
 - a. Food web
 - b. Food plot
 - c. **Habitat**
 - d. Wildlife management

Review—Answer Key

3. Animals that eat plants.
 - a. Carnivores
 - b. Omnivores
 - c. Predators
 - d. Herbivores**
4. On the first level of the food chain are the "_____".
 - a. producers**
 - b. herbivores
 - c. carnivores
 - d. omnivores
5. A food web shows:
 - a. The area planted to maintain wildlife food supply.
 - b. The interacting system of biological community and its nonliving environment.
 - c. An arrangement of predator-prey relationship in an ecosystem.
 - d. The interconnecting food chains in an ecosystem.**
6. A predator is an animal that:
 - a. Eats plants.
 - b. Hunts, kills, and consumes other animals.**
 - c. Eats both plants and animals.
 - d. Is very destructive.
7. Westward expansion of settlers during the 1700's and 1800's was responsible for loss of wildlife habitat and _____.
 - a. Setting of bag limits.
 - b. Aided market hunting**
 - c. Establishment of the world fur trade business.
 - d. Setting aside national parks and wildlife refuges.
8. Federal legislation that brought the federal government into the business of wildlife law enforcement.
 - a. Fish and Wildlife Conservation Act
 - b. North American Waterfowl Management Plan
 - c. Federal Aid in Wildlife Restoration Act
 - d. Lacey Act**

Review—Answer Key

9. Endangered Species Act
- a. Called for the identification of fish and wildlife not taken for sport or commercial purposes.
 - b. Provided for areas of wildlife habitat on farms near crops.
 - c. **Gave authority for protecting rare and endangered species to the U.S. Fish and Wildlife Service.**
 - d. Provided funding for wildlife management by placing an excise tax on firearms and ammunition.
10. An example of a vertebrate animal.
- a. Insect
 - b. Mollusk
 - c. Arachnid
 - d. **Mammal**
11. A characteristic of a mammal.
- a. **The females give milk to their babies.**
 - b. Get oxygen from water through a gill structure.
 - c. Hatch from eggs.
 - d. Body temperature adjusts to surroundings.
12. A large mammal.
- a. Lynx
 - b. Coyote
 - c. Bobcat
 - d. **Deer**
13. A small mammal.
- a. Sheep
 - b. Mountain goat
 - c. **Beaver**
 - d. Pronghorn antelope
14. A characteristic of a fish wildlife.
- a. Have the capacity to maintain a constant body temperature.
 - b. Typically live in the water in the early stages of their lives and move to land as they mature.
 - c. **Body temperature adjusts to surroundings.**
 - d. Have bodies covered with thick skins.

Review—Answer Key

15. A characteristic of a birds.
- a. Provide milk to their young.
 - b. Have a body covered with scales or skin.
 - c. Body temperature adjusts to surroundings.
 - d. Have a body covered with feathers.**
16. An upland nonmigratory bird.
- a. Mallard duck
 - b. Sandhill crane
 - c. Quail**
 - d. Eagle
17. A wetland migratory bird.
- a. Pheasant
 - b. Canvasback duck**
 - c. Hawk
 - d. Wild turkey
18. A raptor.
- a. Grouse
 - b. Snow goose
 - c. Blue heron
 - d. Falcon**
19. A common reptile.
- a. Frog
 - b. Spider
 - c. Salamander
 - d. Turtle**
20. A characteristic of amphibians.
- a. Have paired fins and an exterior covering of scales or skin.
 - b. Typically live in water in the early stages of their lives and move to land as they mature.**
 - c. Have a pair of wings and a pair of legs.
 - d. Females feed milk to their young.

Review—Answer Key

21. All have four pairs of walking legs, plus two other pairs of appendages near their heads.
- a. Insects
 - b. Crustaceans
 - c. **Arachnids**
 - d. Mollusks
22. An endangered species is:
- a. **A plant, animal, and other species threatened with becoming extinct. The species is not reproducing itself in sufficient numbers to assure survival.**
 - b. A wildlife species that exists in small numbers. For some reason, the species may appear to be declining.
 - c. A plant, animal, or other species that faces serious dangers and is likely to become endangered.
 - d. The disappearance of living organisms from the earth. Death of the last member of the species ends the existence of a species.
23. A danger to wildlife populations.
- a. Bag limits
 - b. Improved habitats through agriculture practices
 - c. Hunting seasons
 - d. **Fires**
24. An agricultural practice that supports wildlife.
- a. Remove windbreaks to provide a better habitat for wildlife.
 - b. Drain existing wetlands to assure future wildlife habitats.
 - c. **Provide food plot areas to keep wildlife away from crops.**
 - d. Remove brush and dead trees.
25. A wildlife activity that may cause damage to agriculture.
- a. Provide predator for removing unwanted prey.
 - b. **Feed on agricultural crops.**
 - c. Share the farm habitat with domestic animals.
 - d. Complements livestock for grass on grazing lands.
26. A way to control wildlife damage problems.
- a. Use of fires.
 - b. **Use frightening techniques.**
 - c. Drain wetlands.
 - d. Remove wildlife habitat.

Review—Answer Key

27. More than _____ % of the game is harvested on private land.
- a. 25%
 - b. 40%
 - c. 90%
 - d. **80%**
28. A type of private production area where landowners open their land in exchange for protection against random trespassing.
- a. Commercial wildlife enterprises
 - b. Preserves
 - c. **Cooperatives**
 - d. Farms
29. A government agency involved with wildlife management on private lands.
- a. National Park Service
 - b. Bureau of Land Management
 - c. Corps of Engineers
 - d. **USDA Natural Resources Conservation Service**

Answers to Assignment Sheets**Assignment
Sheet 1****Explain Effects on a Food Chain When Parts are Removed**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 2****Create a Food Web**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 3****Identify Wildlife You See in a Certain Time Span**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 4****Compile a Profile of a Wildlife Species**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 5****Make Management Decisions Concerning a Deer Herd**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 6****Analyze Current Reports Concerning Wildlife Management**

Student performance should be evaluated according to criteria listed on the assignment sheet.

Written Test

Name _____

Date _____ Score _____

Objective 1

Match the terms related to wildlife management with their definitions. Write the corresponding numbers on the blanks provided.

- | | | |
|-----------------|---------------|--------------|
| 1. Carnivores | 6. Food plot | 11. Prey |
| 2. Domesticated | 7. Habitat. | 12. Wildlife |
| 3. Ecosystem | 8. Herbivores | 13. Wildlife |
| 4. Food chain | 9. Omnivores | management |
| 5. Food web | 10. Predator | |

- _____ a. All plants, animals, and other living things that have not been domesticated.
- _____ b. Wildlife taken from nature and raised in a controlled situation.
- _____ c. The area where an animal or plant naturally lives and grows.
- _____ d. The scientifically-based activity of making land produce sustained annual crops of wild game.
- _____ e. The interacting system of biological community and its nonliving environment.
- _____ f. An arrangement of predator-prey relationship in an ecosystem.
- _____ g. Animals that eat plants.
- _____ h. Animals that eat meat.
- _____ i. Animals that eat both animals and plants.
- _____ j. The interconnected food chains within an ecosystem.
- _____ k. Animal that hunts, kills, and consumes other animals.
- _____ l. An animal taken as food by a predator.
- _____ m. Area planted to maintain wildlife food supply.

Written Test

Objective 2

Complete statements concerning a food chain by filling in the blanks with the correct answers. Select your answers from the following: carnivores, herbivores, producers, and omnivores.

- On the first level of the food chain are the "_____."
- On the second level of the food chain are the "_____."
- On the third level of the food chain are the "_____."
- Some organisms consume food at more than one level. These are called "_____."

Objective 3

Show the interconnections that make a food web between the following components. Draw lines with arrows pointing to the consumer (from the food source).

Shrubs and Trees
(including nuts and fruit)

Mountain Lion

Hawk

Robin

Deer

Rabbit

Grasshopper

Grass
(including seeds)

Objective 4

Complete the following statements concerning the predator/prey relationship. Circle or underline the correct words.

- Predators (are) (are not) usually destructive.
- Predators can control the (genetic makeup) (population) of a prey species.
- Predators normally kill the (strong) (weak) individuals of the prey species.
- Humans are the only predators capable of (threatening) (exterminating) a prey species.

Written Test

Objective 5

Complete the following statements concerning the history of wildlife in the United States. Circle or underline the correct words.

- a. Early North America became established in the world fur trade when (settlers and New England merchants) (French and Native Americans) cooperated to trap and ship pelts.
- b. Westward expansion of settlement across the continent was responsible for (loss of wildlife habitat and market hunting) (establishments of game refuges and bag limits).
- c. The first state bag limits and laws against market hunting were established (after World War II) (the late 1800s).
- d. The Pittman-Robertson Act and the Dingell-Johnson Act were suggested and supported by (the Sierra Club and the Nature Conservancy) (hunters and anglers).
- e. "Duck Stamps" in the U.S. and Canada were established to (raise money for waterfowl habitat restoration) (provide federal inspection of ducks and geese).
- f. The following are examples of private fund-raising organizations dedicated to improving wildlife habitat (Audubon Society and Natural Resources Defense Fund) (Ducks Unlimited and Pheasants Forever).

Written Test

Objective 6

Match federal legislation with their definitions. Write the corresponding numbers on the blanks provided.

- | | |
|---|--|
| 1. Lacey Act | 4. Federal Aid in Sport Fishing Restoration Act or Dingell-Johnson Act |
| 2. Fish and Wildlife Conservation Act | 5. Endangered Species Act |
| 3. Federal Aid in Wildlife Restoration Act or Pittman-Robertson Act | 6. Migratory Bird Conservation Act or "Duck Stamp" Program |
| | 7. North American Waterfowl Management Plan |

- _____ a. Brought the federal government into the business of wildlife law enforcement
- _____ b. Provided funding for fish management by taxing fishing and boating equipment
- _____ c. Called for identification of fish and wildlife not taken for sport or commercial purposes
- _____ d. Gave authority for protecting rare and endangered species to the U.S. Fish and Wildlife Service
- _____ e. Provided funding for wildlife management by placing an excise tax on firearms and ammunition
- _____ f. Partnership between U.S. and Canada to protect 37 species of waterfowl shared by both countries

Objective 7

Distinguish between vertebrate and invertebrate wildlife by placing an "X" in the blank beside vertebrate wildlife.

- _____ a. Animals without an internal skeleton.
- _____ b. Animals with backbones.

Objective 8

Select from the following list characteristics of a mammal. Place an "X" in the blanks next to the true statements.

- _____ a. Body temperature adjusts to surroundings.
- _____ b. The females give milk to their babies.
- _____ c. A killer whale is an example of an aquatic mammal.
- _____ d. Have the capacity to maintain a constant body temperature.

Objective 9

Distinguish between small mammals and large mammals by placing an "X" in the blanks next to the large mammals.

- _____ a. Bear
- _____ b. Prairie dog
- _____ c. Beaver
- _____ d. Bighorn sheep
- _____ e. Bison
- _____ f. Elk
- _____ g. Marmot
- _____ h. Muskrat
- _____ i. Moose
- _____ j. Bobcat
- _____ k. Rabbit
- _____ l. Raccoon

Objective 10

Select from the following list characteristics of fish wildlife. Place an "X" in the blanks next to the true statements.

- _____ a. Body temperature adjusts to surroundings.
- _____ b. Females give milk to their babies.
- _____ c. Have the capacity to maintain a constant body temperature.
- _____ d. Have paired fins and an exterior of scales or skin.
- _____ e. Reproduce by laying infertile eggs that are fertilized by the male outside the body of the female.

Written Test

Objective 11

Select from the following list characteristics of birds. Place an "X" in the blanks next to the true statements.

- ☐ a. Have the capacity to maintain a constant body temperature.
- ☐ b. Have a body covered with feathers.
- ☐ c. Are in the Aves scientific class.
- ☐ d. Reproduce by laying infertile eggs that are fertilized by the male outside the body of the female.
- ☐ e. Has a pair of wings and a pair of legs.

Objective 12

Distinguish among major types of birds by placing the proper symbol beside the appropriate birds.

U—Upland nonmigratory

W—Wetland migratory

R—Raptor

- ☐ a. Hawk
- ☐ b. Eagle
- ☐ c. Snow goose
- ☐ d. Teal duck
- ☐ e. Mallard duck
- ☐ f. Falcon
- ☐ g. Quail
- ☐ h. Whooping crane
- ☐ i. Pheasant
- ☐ j. Wild turkey

Objective 13

Select from the following list characteristics of reptiles by placing an "X" in the blanks next to the true statements.

- ☐ a. Reproduce by laying eggs.
- ☐ b. Are ectothermic animals.
- ☐ c. Are endothermic animals.
- ☐ d. Outer covering has scales or plates.

Written Test

Objective 14

Select from the following list characteristics of amphibians by placing an "X" in the blanks next to the true statements.

- _____ a. Typically lives in water in the early stages of their lives and moves to land as they mature.
- _____ b. Frogs, toads, and salamanders are common amphibians.
- _____ c. Outer covering has scales or plates.
- _____ d. Bodies are covered with a thick skin.

Objective 15

Match types of invertebrate wildlife with their descriptions. Write the corresponding numbers on the blanks provided.

- | | | |
|----------------|-------------|----------|
| 1. Arachnids | 3. Insects | 5. Worms |
| 2. Crustaceans | 4. Mollusks | |

- _____ a. Primarily terrestrial animals, they have an exoskeleton, six pairs of legs and most can fly. They reproduce by laying eggs.
- _____ b. An animal with a strong exoskeleton, which is shed as it grows. They have four pairs of appendages plus two pairs of antennae on the head.
- _____ c. Small, soft-bodied animal without an internal skeleton. Some have a hard shell.
- _____ d. Usually has soft bodies and no legs, wings, or antennae.
- _____ e. All have four pairs of walking legs, plus two other pairs of appendages near their heads.

Objective 16

Match the classifications of wildlife that need protection with their descriptions. Write the corresponding numbers on the blanks provided.

- | | |
|-----------------------|-----------------------|
| 1. Extinction | 3. Threatened species |
| 2. Endangered species | 4. Rare species |

- _____ a. A wildlife species that exists in small numbers. For some reason, the species may appear to be declining.
- _____ b. A plant, animal, or other species that faces serious dangers and is likely to become endangered.
- _____ c. A plant, animal, and other species threatened with becoming extinct. The species is not reproducing itself in sufficient numbers to assure survival.
- _____ d. The disappearance of living organisms from the earth. This occurs when a species does not reproduce and dies off. Death of the last member ends the existence of a species.

Written Test

Objective 17

List five dangers to wildlife populations.

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____

Objective 18

List three agricultural practices that support wildlife.

- a. _____
- b. _____
- c. _____

Written Test

Objective 19

Select from the following list the wildlife activities that may cause damage to agriculture by placing an "X" in the blanks next to the true statements.

- ☐ a. Carry diseases
- ☐ b. Prey on domestic livestock and poultry
- ☐ c. Provide recreation
- ☐ d. Feed on agricultural crops
- ☐ e. Compete for grass on grazing lands
- ☐ f. Provide for game hunts
- ☐ g. Feed on stored feed supplies
- ☐ h. Cause damage to trees
- ☐ i. Cause damage to buildings and equipment
- ☐ j. Provide food to hunters

Objective 20

List three ways to control wildlife damage problems.

- a. _____
- b. _____
- c. _____

Objective 21

Select true statements concerning public wildlife and private lands by placing an "X" in the blanks next to the true statements.

- ☐ a. Many landowners prefer to see wildlife on their land.
- ☐ b. Wildlife share with domestic animals the farm habitat including food, shelter, and space.
- ☐ c. Most state and federal wildlife agency money is spent on private lands.
- ☐ d. Many landowners receive compensation for good land management practices from the Department of Land Management.
- ☐ e. About 20% of game wildlife is harvested on private land.

Written Test

Objective 22

Match the types of private wildlife production areas with their descriptions. Write the corresponding numbers on the blanks provided.

- | | |
|------------------------------------|-------------------------------|
| 1. Cooperatives | 4. Exotic and native big game |
| 2. Preserves | ranches |
| 3. Commercial wildlife enterprises | 5. Farms |

- _____ a. Raise and sell wildlife animals, birds, and fish or sell hunting leases
- _____ b. Areas set aside exclusively for owners and members
- _____ c. Provide "package hunts"
- _____ d. Landowners open their land in exchange for protection against random trespassing

Objective 23

List four government agencies involved in wildlife management.

- a. _____
- b. _____
- c. _____
- d. _____

Objective 24

List three career opportunities related to wildlife management.

- a. _____
- b. _____
- c. _____

*Permission to duplicate this test is granted.

Written Test—Answer Key

Objective 1

Match the terms related to wildlife management with their definitions. Write the corresponding numbers on the blanks provided.

- | | | |
|-----------------|---------------|--------------|
| 1. Carnivores | 6. Food plot | 11. Prey |
| 2. Domesticated | 7. Habitat. | 12. Wildlife |
| 3. Ecosystem | 8. Herbivores | 13. Wildlife |
| 4. Food chain | 9. Omnivores | management |
| 5. Food web | 10. Predator | |

- 12 a. All plants, animals, and other living things that have not been domesticated.
- 2 b. Wildlife taken from nature and raised in a controlled situation.
- 7 c. The area where an animal or plant naturally lives and grows.
- 13 d. The scientifically-based activity of making land produce sustained annual crops of wild game.
- 3 e. The interacting system of biological community and its nonliving environment.
- 4 f. An arrangement of predator-prey relationship in an ecosystem.
- 8 g. Animals that eat plants.
- 1 h. Animals that eat meat.
- 9 i. Animals that eat both animals and plants.
- 5 j. The interconnected food chains within an ecosystem.
- 10 k. Animal that hunts, kills, and consumes other animals.
- 11 l. An animal taken as food by a predator.
- 6 m. Area planted to maintain wildlife food supply.

Written Test—Answer Key

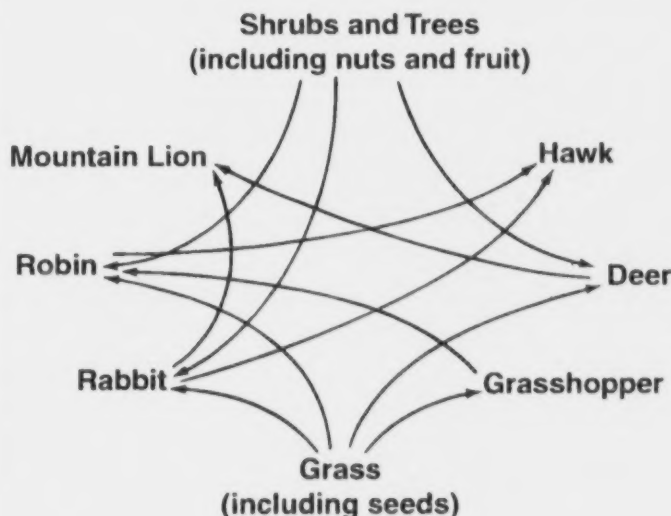
Objective 2

Complete statements concerning a food chain by filling in the blanks with the correct answers. Select your answers from the following: carnivores, herbivores, producers, and omnivores.

- On the first level of the food chain are the "**producers**."
- On the second level of the food chain are the "**herbivores**."
- On the third level of the food chain are the "**carnivores**."
- Some organisms consume food at more than one level. These are called "**omnivores**."

Objective 3

Show the interconnections that make a food web between the following components. Draw lines with arrows pointing to the consumer (from the food source).



Objective 4

Complete the following statements concerning the predator/prey relationship. Circle or underline the correct words.

- Predators (are) (**are not**) usually destructive.
- Predators can control the (genetic makeup) (**population**) of a prey species.
- Predators normally kill the (strong) (**weak**) individuals of the prey species.
- Humans are the only predators capable of (threatening) (**exterminating**) a prey species.

Written Test—Answer Key

Objective 5

Complete the following statements concerning the history of wildlife in the United States. Circle or underline the correct words.

- a. Early North America became established in the world fur trade when (settlers and New England merchants) (**French and Native Americans**) cooperated to trap and ship pelts.
- b. Westward expansion of settlement across the continent was responsible for (**loss of wildlife habitat and market hunting**) (establishments of game refuges and bag limits).
- c. The first state bag limits and laws against market hunting were established (after World War II) (**the late 1800s**).
- d. The Pittman-Robertson Act and the Dingell-Johnson Act were suggested and supported by (the Sierra Club and the Nature Conservancy) (**hunters and anglers**).
- e. "Duck Stamps" in the U.S. and Canada were established to (**raise money for waterfowl habitat restoration**) (provide federal inspection of ducks and geese).
- f. The following are examples of private fund-raising organizations dedicated to improving wildlife habitat (Audubon Society and Natural Resources Defense Fund) (**Ducks Unlimited and Pheasants Forever**).

Written Test—Answer Key

Objective 6

Match federal legislation with their definitions. Write the corresponding numbers on the blanks provided.

- | | |
|---|--|
| 1. Lacey Act | 4. Federal Aid in Sport Fishing Restoration Act or Dingell-Johnson Act |
| 2. Fish and Wildlife Conservation Act | 5. Endangered Species Act |
| 3. Federal Aid in Wildlife Restoration Act or Pittman-Robertson Act | 6. Migratory Bird Conservation Act or "Duck Stamp" Program |
| | 7. North American Waterfowl Management Plan |

- 1 a. Brought the federal government into the business of wildlife law enforcement
- 4 b. Provided funding for fish management by taxing fishing and boating equipment
- 2 c. Called for identification of fish and wildlife not taken for sport or commercial purposes
- 5 d. Gave authority for protecting rare and endangered species to the U.S. Fish and Wildlife Service
- 3 e. Provided funding for wildlife management by placing an excise tax on firearms and ammunition
- 7 f. Partnership between U.S. and Canada to protect 37 species of waterfowl shared by both countries

Objective 7

Distinguish between vertebrate and invertebrate wildlife by placing an "X" in the blank beside vertebrate wildlife.

- a. Animals without an internal skeleton.
- X b. Animals with backbones.

Objective 8

Select from the following list characteristics of a mammal. Place an "X" in the blanks next to the true statements.

- a. Body temperature adjusts to surroundings.
- X b. The females give milk to their babies.
- X c. A killer whale is an example of an aquatic mammal.
- X d. Have the capacity to maintain a constant body temperature.

Written Test—Answer Key

Objective 9

Distinguish between small mammals and large mammals by placing an "X" in the blanks next to the large mammals.

- ☒ a. Bear
- ☐ b. Prairie dog
- ☐ c. Beaver
- ☒ d. Bighorn sheep
- ☒ e. Bison
- ☒ f. Elk
- ☐ g. Marmot
- ☐ h. Muskrat
- ☒ i. Moose
- ☐ j. Bobcat
- ☐ k. Rabbit
- ☐ l. Raccoon

Objective 10

Select from the following list characteristics of fish wildlife. Place an "X" in the blanks next to the true statements.

- ☒ a. Body temperature adjusts to surroundings.
- ☐ b. Females give milk to their babies.
- ☐ c. Have the capacity to maintain a constant body temperature.
- ☒ d. Have paired fins and an exterior of scales or skin.
- ☒ e. Reproduce by laying infertile eggs that are fertilized by the male outside the body of the female.

Written Test—Answer Key

Objective 11

Select from the following list characteristics of birds. Place an "X" in the blanks next to the true statements.

- X a. Have the capacity to maintain a constant body temperature.
- X b. Have a body covered with feathers.
- X c. Are in the Aves scientific class.
- d. Reproduce by laying infertile eggs that are fertilized by the male outside the body of the female.
- X e. Has a pair of wings and a pair of legs.

Objective 12

Distinguish among major types of birds by placing the proper symbol beside the appropriate birds.

U—Upland nonmigratory

W—Wetland migratory

R—Raptor

- R a. Hawk
- R b. Eagle
- W c. Snow goose
- W d. Teal duck
- W e. Mallard duck
- R f. Falcon
- U g. Quail
- W h. Whooping crane
- U i. Pheasant
- U j. Wild turkey

Objective 13

Select from the following list characteristics of reptiles by placing an "X" in the blanks next to the true statements.

- X a. Reproduce by laying eggs.
- X b. Are ectothermic animals.
- c. Are endothermic animals.
- X d. Outer covering has scales or plates.

Written Test—Answer Key

Objective 14

Select from the following list characteristics of amphibians by placing an "X" in the blanks next to the true statements.

- X a. Typically lives in water in the early stages of their lives and moves to land as they mature.
- X b. Frogs, toads, and salamanders are common amphibians.
- c. Outer covering has scales or plates.
- X d. Bodies are covered with a thick skin.

Objective 15

Match types of invertebrate wildlife with their descriptions. Write the corresponding numbers on the blanks provided.

- | | | |
|----------------|-------------|----------|
| 1. Arachnids | 3. Insects | 5. Worms |
| 2. Crustaceans | 4. Mollusks | |

- 3 a. Primarily terrestrial animals, they have an exoskeleton, six pairs of legs and most can fly. They reproduce by laying eggs.
- 2 b. An animal with a strong exoskeleton, which is shed as it grows. They have four pairs of appendages plus two pairs of antennae on the head.
- 4 c. Small, soft-bodied animal without an internal skeleton. Some have a hard shell.
- 5 d. Usually has soft bodies and no legs, wings, or antennae.
- 1 e. All have four pairs of walking legs, plus two other pairs of appendages near their heads.

Objective 16

Match the classifications of wildlife that need protection with their descriptions. Write the corresponding numbers on the blanks provided.

- | | |
|-----------------------|-----------------------|
| 1. Extinction | 3. Threatened species |
| 2. Endangered species | 4. Rare species |

- 4 a. A wildlife species that exists in small numbers. For some reason, the species may appear to be declining.
- 3 b. A plant, animal, or other species that faces serious dangers and is likely to become endangered.
- 2 c. A plant, animal, and other species threatened with becoming extinct. The species is not reproducing itself in sufficient numbers to assure survival.
- 1 d. The disappearance of living organisms from the earth. This occurs when a species does not reproduce and dies off. Death of the last member ends the existence of a species.

Written Test—Answer Key

Objective 17

List five dangers to wildlife populations.

Any five of the following:

- Illegal hunting
- Predators
- Starvation
- Droughts
- Storms
- Diseases
- Parasites
- Fires
- Accidents
- Human activities including pollution
- Loss of habitats through development or agriculture

Objective 18

List three agricultural practices that support wildlife.

Any three of the following:

- Farm around hills (contours) to control sediment that might enter and ruin ponds, lakes and streams
- Leave fence rows undisturbed to provide cover so wildlife can travel to other areas
- Provide farm ponds and tanks for wildlife drinking water
- Use windbreaks and shelter belts to provide habitat for wildlife
- Seed legumes and grasses to provide food cover for wildlife
- Prevent overgrazing on grassland to protect cover, nesting clover, and food for wildlife
- Leave crop residue on land to provide food for wildlife and control erosion
- Provide food plot areas to keep wildlife away from crops
- Maintain existing wetlands to assure future wildlife habitat

Written Test—Answer Key

Objective 19

Select from the following list the wildlife activities that may cause damage to agriculture by placing an "X" in the blanks next to the true statements.

- ☒ a. Carry diseases
- ☒ b. Prey on domestic livestock and poultry
- ☐ c. Provide recreation
- ☒ d. Feed on agricultural crops
- ☒ e. Compete for grass on grazing lands
- ☐ f. Provide for game hunts
- ☒ g. Feed on stored feed supplies
- ☒ h. Cause damage to trees
- ☒ i. Cause damage to buildings and equipment
- ☐ j. Provide food to hunters

Objective 20

List three ways to control wildlife damage problems.

Any three of the following:

- Reduce the number of destructive animals.
- Provide fencing or other mechanical barriers.
- Use frightening techniques.
- Encourage adequate game harvest by hunters.
- Adjust agricultural practices.
- Establish feeding and resting areas on non-crop lands.

Objective 21

Select true statements concerning public wildlife and private lands by placing an "X" in the blanks next to the true statements.

- ☒ a. Many landowners prefer to see wildlife on their land.
- ☒ b. Wildlife share with domestic animals the farm habitat including food, shelter, and space.
- ☐ c. Most state and federal wildlife agency money is spent on private lands.
- ☐ d. Many landowners receive compensation for good land management practices from the Department of Land Management.
- ☐ e. About 20% of game wildlife is harvested on private land.

Written Test—Answer Key

Objective 22

Match the types of private wildlife production areas with their descriptions. Write the corresponding numbers on the blanks provided.

- | | |
|------------------------------------|-------------------------------|
| 1. Cooperatives | 4. Exotic and native big game |
| 2. Preserves | ranches |
| 3. Commercial wildlife enterprises | 5. Farms |

- 5 a. Raise and sell wildlife animals, birds, and fish or sell hunting leases
- 2 b. Areas set aside exclusively for owners and members
- 3 or 4 c. Provide "package hunts"
- 1 d. Landowners open their land in exchange for protection against random trespassing

Objective 23

List four government agencies involved in wildlife management.

Any four of the following:

- State wildlife, conservation, and natural resource departments
- U.S. Fish and Wildlife Service
- Forest Services
- National Park Service
- Natural Resources Conservation Service
- Corps of Engineers
- Bureau of Reclamation
- Bureau of Land Management

Objective 24

List three career opportunities related to wildlife management.

Any three of the following:

- Fishery biologist
- Hatchery manager
- Wildlife biologist
- Refuge manager
- Range management specialist
- Law enforcement
- Technicians (biological, fish, and wildlife)
- Conservationist
- Zoologist
- Writer
- Wildlife photographer

*Permission to duplicate this test is granted.

Food Chains

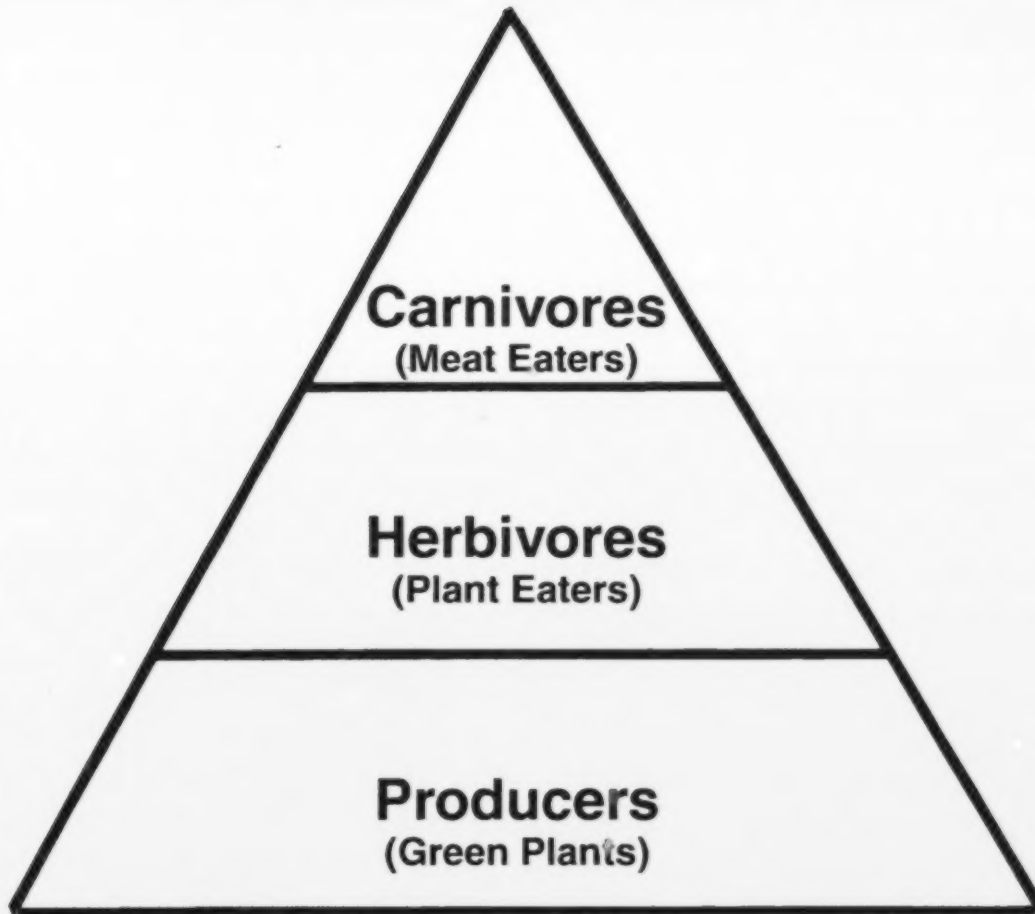
Grass → Grasshopper → Frog

Snake → Hawk

Grass, Tree Leaves → Deer → Mountain Lion

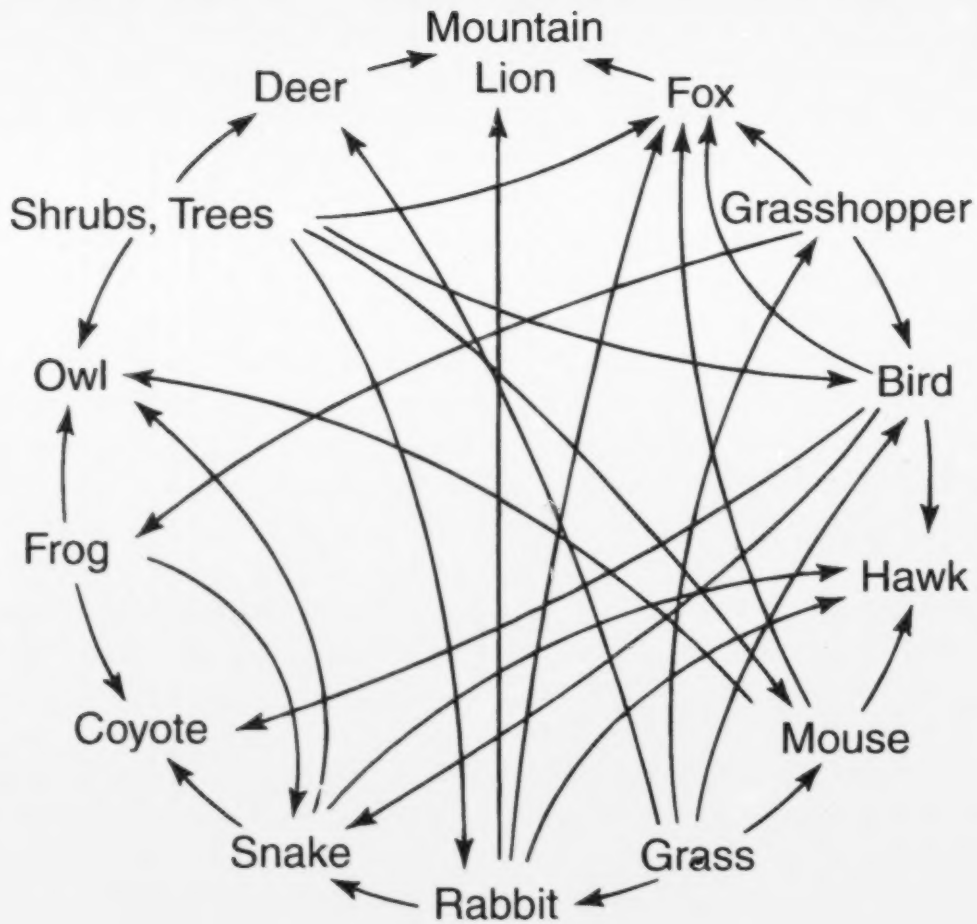
Grass → Mouse → Owl → Hawk

Biotic Pyramid



Note: A pyramid shape is often used to show the food chain concept because a great many more producers are required to support herbivores, and more herbivores are needed to support carnivores. Omnivores can occupy both the middle and top levels of the pyramid depending on their food source at the time.

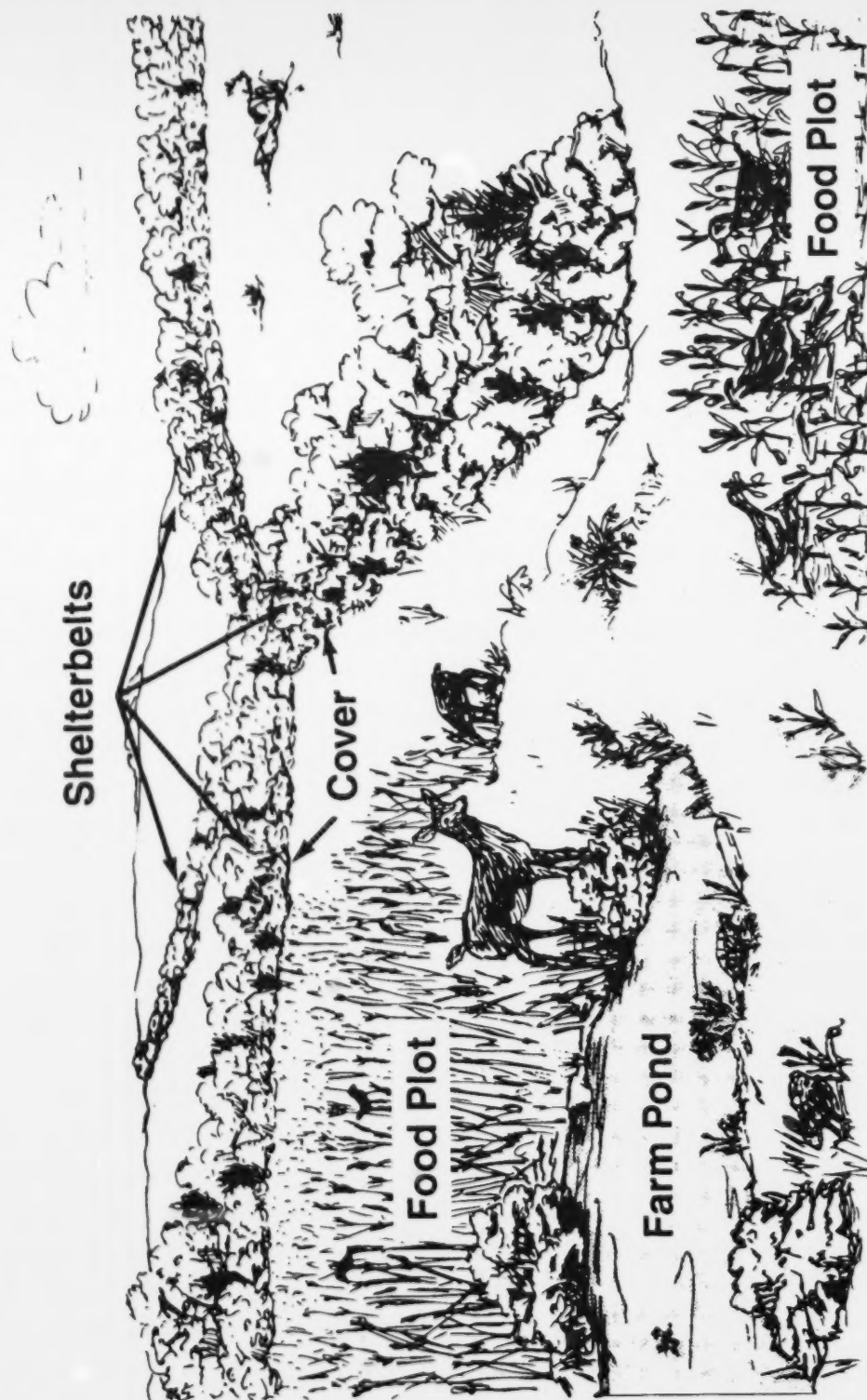
Food Web



Note: Arrows point to the consumer.

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Agricultural Practices That Support Wildlife



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* Assignment Sheets and Job Sheet are located in the Student Workbook.

Instructional
Plan

Suggested Activities

Preparation

- Review the objective sheet. Study the specific objectives to determine the order in which you will present the objectives.
- Review the suggested lesson plan. The plan identifies an order for instruction to take place. Each "day" represents a 50-minute class period. The plan is designed to cover the specific objectives over a 15-day period. Additional days and/or activities may be added. (Note: You may want to change days to specific dates. Example: Day 1 may become Monday, April 5, Day 2 = Tuesday, April 6, and so forth.) You will want to localize, supplement, and personalize the plan to fit your situation.
- Review the teaching suggestions included in this instructional plan section to plan classroom activities. Also note the suggestions for supplemental resources.
- Plan your delivery/application to take advantage of student learning styles and to accommodate special-needs students.
- Obtain films, videotapes, and other materials to supplement instruction of this unit. See "Resources Used in Developing This Unit" and "Suggested Supplemental Resources" for more information.
- Make transparencies or computer presentation from the transparency masters included in this unit. These appear in the teacher edition only and should be used with objectives as indicated below.

TM 1—Components of a Habitat (Objective 2)

TM 2—Habitat Improvement (Objective 5)

TM 3—Habitat Improvement (Continued) (Objective 5)

TM 4—Habitat Destruction (Objective 7)

TM 5—Lakes, Ponds, and Pothole Habitats (Objective 9)

TM 6—River and Stream Habitats (Objective 10)

TM 7—Wetland Habitat (Objective 11)

TM 8—Woodland Habitat (Objective 12)

TM 9—Rangeland Habitat (Objective 13)

TM 10—Farmland Habitat (Objective 14)

TM 11—Urban Habitat (Objective 15)

Suggested Activities

- Use the following teaching supplements to enhance your delivery and application activities.

TS 1 — Construct Nesting Sites (Objective 6)

TS 2 — Determine the Carrying Capacity of a Pond (Objective 9)

TS 3 — Analyze Current Reports Concerning Wildlife Habitats

- Use Student Supplement 1—List of Selected Wildlife Foods with Assignment Sheet 5.
- Select teacher components (written test, unit review, teacher supplements) you want to distribute to your students. Copy and prepare these components for distribution.
- Prepare classroom. Put up posters and charts and display articles and other references related to the objectives of this unit.

Delivery and Application

- Discuss unit and specific objectives.
- Discuss information sheets. Implement teaching plan to localize, supplement, and personalize the unit. Reinforce basic academic and workplace skills when applicable.
- Discuss the assignment sheets and job sheet. Review with students the criteria for evaluation of each of these activities.

Teaching Suggestions

The skill areas appearing in bold-face type in the teaching suggestions refer to the academic and workplace skills identified in *What Work Requires of Schools: A SCANS Report for America 2000* and *Workplace Basics: The Skills Employers Want*. These have been adapted by MAVCC.

- Arrange for representatives of your state's wildlife department or wildlife specialists from your state land-grant university's Cooperative Extension Service to visit the class to discuss the need for and the practice of biology-based wildlife management and habitat maintenance and improvement. This visit, and continued cooperation of the various wildlife experts, is very important to this unit's activities, especially the advanced sections. The individual or individuals called upon to visit the class will also be asked to provide technical information from their various agencies concerning wildlife habitat improvement, species selection, and farm pond management. (**Listening; acquiring scientific information**)

Suggested Activities

- Meet with and enlist local land and property owners who would allow class members to use their property to survey wildlife species, food sources, habitat conditions, etc. This is particularly important for advanced assignments such as non-game bird surveys and wildlife food surveys.
- Arrange for a tour of a city, state, or national park, recreation area, or refuge's nature center. Prepare students to ask questions on the need for and practice of biology-based wildlife management and habitat maintenance and improvement. **(Listening; acquiring scientific information; acquiring needed resources)**
- Tour an area being managed as an animal wildlife habitat. Have the manager of the area explain how it is being managed to promote the desired species. Determine the featured species and any other species of the area. Assess the stages of habitat succession found in the area. **(Listening; acquiring scientific information)**
- Investigate your school grounds, a local park, or a student's backyard for possible use as a habitat for small species of wildlife. First, identify the wildlife species (Assignment Sheets 5 and 6) that may be appropriate such as butterflies, squirrels, rabbits, and song birds. Second, identify the modifications that would be needed to attract the desired wildlife species to the area. Third, prepare a plan (Assignment Sheet 1) that includes sketches of the area and descriptions of the work to be done. Get the assistance of a wildlife specialist, biologist, or county agent. **(Acquiring scientific information; analyzing and applying what has been studied to a specific task; critical thinking)**
- Have your students work with a science or biology class to accomplish a group project such as construction of bluebird trails, fish shelters, or other habitat enhancing project such as Teacher Supplement 5—Construct Nesting Sites. **(Organizational effectiveness; teamwork; leadership; applying scientific techniques)**
- Invite members of Quail Unlimited, Ducks Unlimited, or Pheasants Forever, to address the class about habitat improvement activities their organizations have been involved with. Suggest they bring audio-visual or printed material to reinforce their presentations. **(Listening)**

Evaluation

- Give and evaluate Wildlife Habitats Review.
- Copy written test and give to students as pretest.

Suggested Activities

- Evaluate assignment sheets. See the evaluation criteria listed at the top of each assignment sheet and the component "Answers to Assignment Sheets." Evaluation may be localized, personalized, or individualized to fit your situation.
- Evaluate job sheets. See the evaluation criteria listed at the top of each job sheet. Evaluation may be localized, personalized, or individualized to fit your situation.
- Give and evaluate written test. Record student's written test score in your grade book and on the student's competency profile.
- Measure competency gains by comparing written pretest scores with posttest scores.
- Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas of improvement.
- Reteach and retest as required.

Instructions for Evaluating Student Performance

- When the student is ready to perform a specific task, obtain a copy of the assignment sheet or job sheet which may be found in the student workbook.
- Assignment Sheets — Once the student has completed an assignment sheet, evaluate the student's work using the evaluation criteria. If the student's work is unsatisfactory, have the student review the assignment sheet and submit their work for evaluation again. Record the appropriate level of competency on the student's competency profile.
- Job Sheets — A student may be evaluated for process, product, or both.

Process evaluation—Place a mark in the box to the left of each designated checkpoint if the student has satisfactorily achieved the step(s) for each checkpoint area. If the student is unable to correctly complete the procedure, have the student review the materials and try again.

Product evaluation—Once the student has satisfactorily completed the procedure, rate the student product (outcome) using the criteria which have been provided as part of the job sheet. If the student's product is unacceptable, have the student review the materials and submit another product for evaluation.

Record the appropriate level of competency on the student's competency profile.

Suggested Activities

Resources Used in Developing This Unit

- Sample performance evaluation keys have been provided below. Many other keys are available. Select one rating (grading scale) which best fits your program needs.

Sample A

- 4—**Skilled**—Can perform job with no additional training.
- 3—**Moderately skilled**—Has performed job during training program; limited additional training may be required.
- 2—**Limited skill**—Has performed job during training program; additional training is required to develop skill.
- 1—**Unskilled**—Is familiar with process, but is unable to perform job.
- 0—**No exposure**—No information or practice provided during training program.

Sample B

- Yes**—Can perform job with no additional training.
- No**—Is unable to perform job satisfactorily.

- Encourage students to continue their portfolio. The portfolio should be a record of the student's progress in the study of natural resources.

Note: URLs change frequently. Any of the web sites may have moved.

- Camp, William G. and Thomas B. Daugherty, *Managing Our Natural Resources (4th Edition)*, Albany, NY: Delmar Publishers, Inc., 2002.
www.agriscience.delmar.com
- Lee, Jasper S., *Natural Resources and Environmental Technology*, Danville, IL: Interstate Publishers, Inc., 2000.
www.interstatepublishers.com
- Porter, Lynn, Jasper S. Lee, Diana L. Tumer, and Malcolm Hillian, *Environmental Science and Technology (2nd Edition)*, Danville, IL: Interstate Publishers, Inc., 2003.
www.interstatepublishers.com
- Stutzenbaker, Charles D., Brenda J. Schell, Michael K. Swan, Jasper S. Lee, and Jeri Mattics Omemik, *Wildlife Management Science and Technology (2nd Edition)*, Danville, IL: Interstate Publishers, Inc., 2003.
- *The Audubon Society Field Guide to North American Birds (Western Region)*, New York, NY: Alfred A. Knopf, 1992.
- *Wildlife Habitat Evaluation Handbook*, National 4-H Council, 7100 Connecticut Ave., Chevy Chase, MD 20815, 1991.

Suggested Activities

Suggested Supplemental Resources

- Morrison, Michael L., *Wildlife — Habitat Relationships: Concepts and Applications*, University of Wisconsin Press, 1998.

- *The Audubon Society Field Guides to ...*
Series covers various wildlife topics
www.amazon.com

- Instructional Materials Service
Cornell University
Kennedy Hall
Ithaca, NY 14853
(607) 255-9252
www.cornell.edu/dep/education/projects/IMS/ims.html

Computer software — *Wildlife Series: Limiting Factors and Carrying Capacity*. Relates habitat, wildlife, human effects, and student's personal values.

- Wildlife Habitats
P.O. Box 420
New Market, MD 21774
Phone: 301-831-9217
www.wildlifehabitats.com

Site contains information about wildlife habitats, deer protection and control, water quality, and landscape design.

- National Wildlife Federation
1100 Wildlife Center Drive
Reston, VA 20190
Phone: 703-438-6000
www.nwf.org

Non-profit, member-supported conservation group uniting individuals, organizations, businesses and government to protect wildlife, wild places, and the environment.

Home page selections include:

- *Nature in Your Neighborhood Educator's Guide* contains interdisciplinary activities designed to introduce students to wildlife they can find in their own backyard. Activities are designed to teach young people about habitats, species, and environmental stewardship. Available free as pdf file.
- Attracting Wildlife—Tips on how to attract specific types of wildlife to your yard
- Identify the Trees in Your Neighborhood
- Conservation Directory (environmental groups)
- Conservation
- Environmental Education
- Kids and Teens
- National Wildlife Week activities

Suggested Activities

Schoolyard Habitat Certification Program

www.nwf.org/schoolyardhabitats

Site provides information on how to turn your school or facility grounds into a NWF certified Schoolyard Habitats site. Provides unique, hands-on outdoor learning opportunities. Educator resources and workshops.

Backyard Wildlife Habitat Certification Program

www.nwf.org/backyardwildlifehabitats

Site provides information on how to certify your backyard as a habitat site. Site includes: habitat planner, tips and projects, create workplace habitat, native plant guide, and monitor frogs and toads.

- Virginia Department of Forestry
Fontaine Research Park
900 Natural Resources Drive, Suite 800
Charlottesville, VA 22903
Phone: 434-977-6555
www.dof.state.va.us/mgt/wildlife

Site was developed by Virginia Department of Game and Fisheries (DGIF) and Virginia Tech. Site has numerous topics including: Wildlife Habitat Management, Managing for Specific Wildlife, Tree Identification, Tree Selection, Tree Planting Guide, Wildlife Habitats, Wildlife Identification, and links to other wildlife sites.

- Deer Flat National Wildlife Refuge
13751 Upper Embankment Road
Nampa, ID 83686
Phone: 208-467-1019
<http://deerflat.fws.gov/indextext.htm>

Example of a National Wildlife Refuge site. Web site contains: About the Refuge, Visiting the Refuge, Refuge Happenings, Deer Flat for Kids, and Deer Flat for Teachers.

- Books about Nature web site provides links to National Parks, Wildlife Refuges, and Sanctuaries.
www.booksabournature.com/parks_refuges
- Project Wet (Water Education for Teachers)
201 Culbertson Hall
Montana State University
P.O. Box 170575
Bozeman, MT 59717
www.projectwet.org

Similar to Project Wild. Project Wet has curriculum and activity guides available to teachers who attend training workshops.

Suggested Lesson Plan

Day 1

Introduction:

- Review the unit and specific objectives and the plan for completing this unit.
- Have students read the introduction.
- Discuss the introduction. Ask questions such as: What wildlife do you see each day? What can we do to improve wildlife habitats?
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 2—Components of a habitat.
- Use TM 1 to illustrate components of a habitat.
- Discuss Objective 3—Objectives of wildlife habitat management.
- Discuss Objective 4—Habitat management principles.
- Discuss Objective 5—Common tools and techniques of habitat improvement.
- Use TM 2 and 3 to illustrate habitat improvement.

Closure:

- Review discussion on introductory remarks.
- Review Objectives 2, 3, and 4.

Evaluation:

- Non-applicable.

Day 2

Introduction:

- Review Objective 5.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 6—Ways to improve wildlife habitats.
- Assign Assignment Sheet 1—Lay Out and Identify Ways to Improve a Local Habitat.
 - Have students read introduction and directions.
 - Discuss introduction, directions, and review evaluation criteria.
 - Review possible sites, then assign each student a site.
 - Discuss due date for Assignment Sheet 1 (Suggest Day 14).

Closure:

- Review Objective 6.
- Discuss selection of a pond site for Assignment Sheet 2.

Evaluation:

- Non-applicable

Suggested Lesson Plan

Day 3

Introduction:

- Review progress on Assignment Sheet 1. Make sure each student has selected a site.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 7—Causes of habitat destruction.
- Use TM 4 to illustrate habitat destruction.
- Discuss Objective 8—Types of wildlife habitats.
- Discuss Objective 9—Lakes, ponds, playa lake, and pothole habitats.
- Use TM 5 to illustrate lakes, ponds, playa lake, and pothole habitats.
- Assign Assignment Sheet 2—Develop a Management Plan for a Farm Pond for Sport Fishing.
 - Have students read the introduction and directions.
 - Discuss introduction, directions, and evaluation criteria.
 - Determine pond site(s).
 - Study the habitat needed for fish.
 - Evaluate the pond site.
- Provide supervised study for students to review questions on the pond management survey.

Closure:

- Review Objectives 7 and 8.

Evaluation:

- Non-applicable.

Day 4

Introduction:

- Review Objective 9.
- Review progress on Assignment Sheet 2.
- State the objectives for today's lesson.

Delivery and Application:

- Visit pond site.
- Provide supervised study on Assignment Sheet 2.
 - Determine a game fish for sport fishing in the pond.
 - Complete answering questions on the pond management survey.
 - Write a report describing the current condition of the pond, what habitat it provides, and what needs to be done to improve its habitat for the game fish selected.
 - Detail with drawings and maps construction or other management activities.

Closure:

- Review progress on Assignment Sheet 2.

Evaluation:

- Non-applicable.

Suggested Lesson Plan

Day 5

Introduction:

- Review progress on Assignment Sheet 2. Assign due date for Day 6.
- State the objectives for today's lesson.

Delivery and Application:

- Provide supervised study for completion of Assignment Sheet 2.

Closure:

- Remind students Assignment Sheet 2 will be due at next class.

Evaluation:

- Non-applicable.

Day 6

Introduction:

- Review progress on Assignment Sheet 2.
- State the objectives for today's lesson.

Delivery and Application:

- Have students discuss their management plans for a farm pond for sport fishing.
- Turn in Assignment Sheet 2.
- Discuss Objective 10—River and stream habitats.
- Use TM 6 to illustrate river and stream habitats.
- Discuss Objective 11—Wetland habitats.
- Use TM 7 to illustrate wetland habitats.

Closure:

- Review Objective 10.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 2 according to criteria stated on assignment sheet.
- Record student's grade on Assignment Sheet 2 in grade book.
- Record the appropriate level of competency on each student's competency profile.

Day 7

Introduction:

- Return Assignment Sheet 2. Discuss, if necessary.
- Review progress on Assignment Sheet 1.
- Review Objective 11.
- State the objectives for today's lesson.

Delivery and Application:

- Assign Assignment Sheet 3—Identify Ways to Improve A Wetland Habitat.
 - Have students read introduction and directions.
 - Discuss introduction, directions, and evaluation criteria.
 - Provide supervised study for completion of assignment sheet.
 - Turn in Assignment Sheet 3.
- Discuss Objective 12—Woodland habitats.

Suggested Lesson Plan

- Use TM 8 to illustrate woodland habitats.
- Discuss Objective 13—Rangeland habitats.
- Use TM 9 to illustrate rangeland habitats.

Closure:

- Review Objective 12.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 3 according to criteria stated on assignment sheet.
- Record student's grade on Assignment Sheet 3 in grade book.
- Record the appropriate level of competency on each student's competency profile.

Day 8

Introduction:

- Return Assignment Sheet 3. Discuss, if necessary.
- Review progress on Assignment Sheet 1.
- Review Objective 13.
- State the objectives for today's lesson.

Delivery and Application:

- Assign Assignment Sheet 4—Determine the Carrying Capacity of a Rangeland Habitat.
 - Discuss introduction, directions, and evaluation criteria.
 - Provide supervised study for students to complete the assignment sheet.
 - Turn in Assignment Sheet 4.
- Discuss Objective 14—Farmland habitats.
- Use TM 10 to illustrate farmland habitats.
- Discuss Objective 15—Urban habitats.
- Use TM 11 to illustrate urban habitats.

Closure:

- Review Objective 14.
- Select a site for Assignment Sheet 5.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 4 according to criteria stated on assignment sheet.
- Record student's grade on Assignment Sheet 4 in grade book.
- Record the appropriate level of competency on each student's competency profile.

Day 9

Introduction:

- Return Assignment Sheet 4. Discuss, if necessary.
- Review progress on Assignment Sheet 1.
- Review Objective 15.
- State the objectives for today's lesson.

Suggested Lesson Plan

Day 10

Delivery and Application:

- Assign Assignment Sheet 5—Survey Wildlife Foods.
 - Discuss introduction, directions, and evaluation criteria.
 - Visit selected site. Have students note the presence of wildlife foods and its abundance.
 - Provide supervised study to:
 1. Compile a list of wildlife foods available and possible wildlife species that would be present. Also have students note reasons why they think certain species are not present.
 2. Select two species and write a report on their suggestion for improving and providing additional food sources for these species
 - Assignment Sheet will be due during next class.

Closure:

- Review progress on Assignment Sheet 5.

Evaluation:

- Non-applicable.

Introduction:

- Review progress on Assignment 1.
- Review progress on Assignment 5.
- State the objectives for today's lesson.

Delivery and Application:

- Provide supervised study for completion of Assignment Sheet 5.
- Have students discuss their lists and report.
- Turn in Assignment Sheet 5.
- Assign Assignment Sheet 6—Survey Non-Game Birds at a Feeding Station.
 - Discuss introduction, directions, and evaluation criteria.
 - Discuss due date of Day 13.
- Assign Job Sheet 1—Increase Hummingbird Habitat.
 - Discuss introduction, directions and evaluation criteria.
 - Assign teams (3-4 students).
 - Discuss possibility of Assignment Sheet 6 and Job Sheet 1 complimenting each other.
 - Due date: Day 13.

Closure:

- Review Assignment Sheet 6 and Job Sheet 1.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 5 according to criteria stated on assignment sheet.
- Record student's grade on Assignment Sheet 5 in grade book.
- Record the appropriate level of competency on each student's competency profile.

Suggested Lesson Plan

Day 11

Introduction:

- Return Assignment Sheet 5. Discuss, if necessary.
- Review progress on Assignment Sheet 1.
- Review progress on Assignment Sheet 6.
- Review team progress on Job Sheet 1.
- State the objectives for today's lesson.

Delivery and Application:

- Provide supervised study for completion of Assignment Sheets 1 and 6 and Job Sheet 1.

Closure:

- Non-applicable.

Evaluation:

- Non-applicable.

Day 12

Introduction:

- Review progress on Assignment Sheet 1.
- Review progress on Assignment Sheet 6.
- Review team progress on Job Sheet 1.
- State the objectives for today's lesson.

Delivery and Application:

- Provide supervised study for completion of Assignment Sheets 1 and 6 and Job Sheet 1.

Closure:

- Remind students that Assignment Sheet 6 and Job Sheet 1 are due during next class.
- Remind student that Assignment Sheet 1 is due Day 14.

Evaluation:

- Non-applicable.

Day 13

Introduction:

- Review progress on Assignment Sheet 1.
- Review progress on Assignment Sheet 6.
- Review team progress on Job Sheet 1.
- State the objectives for today's lesson.

Delivery and Application:

- Supervised study for completion of Assignment Sheet 6 and Job Sheet 1.
- Have students discuss Assignment Sheet 6 reports.
- Have students discuss Job Sheet 1 summaries.
- Turn in Assignment Sheet 6 and Job Sheet 1.

Suggested Lesson Plan

Day 14

Closure:

- Remind students that Assignment Sheet 1 is due during next class.
- Remind students that the Wildlife Habitats Review will be taken during next class.
- Remind student that the written test will be taken on Day 15.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 6 according to criteria stated on assignment sheet.
- Record student's grade on Assignment Sheet 6 in grade book.
- Record the appropriate level of competency on each student's competency profile.
- Evaluate each student's performance on Job Sheet 1 according to criteria stated on assignment sheet.
- Record student's grade on Job Sheet 1 in grade book.
- Record the appropriate level of competency on each student's competency profile.

Introduction

- Return Assignment Sheet 6 and Job Sheet 1. Discuss, if necessary.
- Review progress on Assignment Sheet 1.
- State the objectives for today's lesson.

Delivery and Application:

- Give Wildlife Habitats Review.
- Discuss findings for Assignment Sheet 1.
- Turn in Assignment Sheet 1.

Closure:

- Review for written test

Evaluation:

- Evaluate each student's performance on Wildlife Habitats Review according to answer key.
- Record student's grade for the unit review in grade book.
- Evaluate each student's performance on Assignment Sheet 1 according to criteria stated on assignment sheet
- Record student's grade on Assignment Sheet 1 in grade book.
- Record the appropriate level of competency on each student's competency profile.

Day 15

Introduction:

- Return Wildlife Habitats Review and discuss answers.
- Review for written test.
- State the objectives for today's lesson.

Delivery and Application:

- Give written test.
- Return Assignment Sheet 1 and discuss.

Suggested Lesson Plan

Closure:

- Review unit objectives.
- Review next lesson.

Evaluation:

- Evaluate student performance on written test using answer key
Note: Develop teaching strategies for students who did not achieve minimum criteria.
- Record written test grade in grade book.
- Record written test score on student's competency profile
- Return written test and discuss answers at next class.

Wildlife Habitats Review

Name _____ Overall Rating _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate serious effort was taken in completing worksheet	_____

Introduction

Habitat management usually has a goal of meeting the needs of a featured species or a mix of species. The habitat requirements of the species must be known. The resources in an area must be assessed and practices followed to promote the desired species. It is important that you understand the importance of habitat production and the problems to be overcome.

Directions

Answer the following questions concerning wildlife habitats. For help, refer to the information sheets in this unit. Circle the correct response for each question.

1. The area where a plant or animal naturally lives and grows.
 - a. Habitat
 - b. Canopy
 - c. Edge
 - d. Home range
2. Factors that restrict the population potential of a species.
 - a. Habitat component
 - b. Limiting factors
 - c. Carrying capacity
 - d. Environment
3. As a component of a habitat, food:
 - a. Is needed for blood composition and to regulate body temperature.
 - b. Provides nutrient transport throughout the body.
 - c. Provides nutrients for growth, maintenance, and reproduction.
 - d. Protects wildlife animals from adverse environment conditions.
4. An objective of wildlife habitat management.
 - a. To determine the habitat requirements of specific wildlife.
 - b. To assure that a wildlife species reaches its maximum potential.
 - c. To insure that a habitat does not exceed its carrying capacity.
 - d. To maintain a quality habitat as it exists in a natural ecosystem.

Review

5. Each area of land (habitat) has a certain capacity for the number of animals of any one species that it can support. This is called its:
 - a. Home range
 - b. Territory
 - c. Carrying capacity
 - d. Limiting factor
6. An edge:
 - a. Provides nesting places for species whose natural habitat has been damaged.
 - b. Is established to provide a change between types of cover.
 - c. Is used to control the direction of stream flow.
 - d. Provides a habitat for fish as well as a watering place for other wildlife.
7. Food plots are planted to:
 - a. Provide escape cover, as well as protection from soil from wind erosion.
 - b. Provide a change between types of cover.
 - c. Change the chemical composition of the water or soil either to encourage or discourage various plant and animal species.
 - d. Provide food and cover habitat.
8. The leaves, shoots, and twigs of trees and shrubs available for animal consumption is called:
 - a. Mast
 - b. Canopy
 - c. Browse
 - d. Roosts
9. One way to improve cover in a wildlife habitat is to:
 - a. Improve springs and water seeps.
 - b. Increase mast or fruit production.
 - c. Build brush piles.
 - d. Prevent water pollution.
10. A cause of habitat destruction.
 - a. Increase mast or fruit production
 - b. Overgrazing
 - c. Potholes
 - d. Brush piles

Review

11. Land where the water table is usually at or near the surface or the land or is covered by shallow water.
 - a. Lakes, ponds, and potholes
 - b. Rangeland
 - c. Wetland
 - d. Woodland
12. Land used for agricultural practices.
 - a. Rangeland
 - b. Wetland
 - c. Farmland
 - d. Woodland
13. A way to protect lakes, ponds, and pothole habitats.
 - a. Use deflectors to create natural pools.
 - b. Fence shoreline to control livestock grazing and watering.
 - c. Control water levels.
 - d. Pile brush near the water's edge.
14. A component of river and stream habitats is riffles: Riffles is:
 - a. A continuous flow of water with moderate spring runoff at best.
 - b. A certain amount of water needed to maintain stream habitat.
 - c. An area near riverbanks that provides a breeding ground for insects used as food for fish.
 - d. A shallow area in a stream that causes broken water.
15. An ideal wetland is _____ open water and _____ marsh.
 - a. one-half; one-half
 - b. one-third; two-thirds
 - c. two-thirds; one-third
 - d. one-fourth; three-fourths
16. Release cut is:
 - a. Preferred by large numbers of wildlife.
 - b. Thinning of old shrub growth to allow new growth.
 - c. Removal of dead trees and brush.
 - d. An area of the forest that does not support trees.

Review

17. The _____ layer of a rangeland habitat includes short, mid, and tall grass species.
 - a. subsurface
 - b. midstory
 - c. canopy
 - d. surface
18. A component of a farmland habitat.
 - a. Shelterbelts
 - b. Landscape areas and lawns
 - c. Forest openings
 - d. Potholes, playa lakes, and marsh
19. One way to protect urban habitats.
 - a. Fence to protect from wildlife grazing and watering.
 - b. Provide bird houses, feeders, and baths.
 - c. Seed marginal lands to grasses.
 - d. Restrict clean mowing of pastures and fence rows.

Wildlife Habitats Review—Answer Key

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate serious effort was taken in completing worksheet	_____

1. The area where a plant or animal naturally lives and grows.
 - a. **Habitat**
 - b. Canopy
 - c. Edge
 - d. Home range
2. Factors that restrict the population potential of a species.
 - a. Habitat component
 - b. **Limiting factors**
 - c. Carrying capacity
 - d. Environment
3. As a component of a habitat, food:
 - a. Is needed for blood composition and to regulate body temperature.
 - b. Provides nutrient transport throughout the body.
 - c. **Provides nutrients for growth, maintenance, and reproduction.**
 - d. Protects wildlife animals from adverse environment conditions.
4. An objective of wildlife habitat management.
 - a. To determine the habitat requirements of specific wildlife.
 - b. To assure that a wildlife species reaches its maximum potential.
 - c. To insure that a habitat does not exceed its carrying capacity.
 - d. **To maintain a quality habitat as it exists in a natural ecosystem.**

Review—Answer Key

5. Each area of land (habitat) has a certain capacity for the number of animals of any one species that it can support. This is called its:
 - a. Home range
 - b. Territory
 - c. **Carrying capacity**
 - d. Limiting factor
6. An edge:
 - a. Provides nesting places for species whose natural habitat has been damaged.
 - b. **Is established to provide a change between types of cover.**
 - c. Is used to control the direction of stream flow.
 - d. Provides a habitat for fish as well as a watering place for other wildlife.
7. Food plots are planted to:
 - a. Provide escape cover, as well as protection from soil from wind erosion.
 - b. Provide a change between types of cover.
 - c. Change the chemical composition of the water or soil either to encourage or discourage various plant and animal species.
 - d. **Provide food and cover habitat.**
8. The leaves, shoots, and twigs of trees and shrubs available for animal consumption is called:
 - a. Mast
 - b. Canopy
 - c. **Browse**
 - d. Roosts
9. One way to improve cover in a wildlife habitat is to:
 - a. Improve springs and water seeps.
 - b. Increase mast or fruit production.
 - c. **Build brush piles.**
 - d. Prevent water pollution.
10. A cause of habitat destruction.
 - a. Increase mast or fruit production
 - b. **Overgrazing**
 - c. Potholes
 - d. Brush piles

Review—Answer Key

11. Land where the water table is usually at or near the surface or the land or is covered by shallow water.
- a. Lakes, ponds, and potholes
 - b. Rangeland
 - c. Wetland**
 - d. Woodland
12. Land used for agricultural practices.
- a. Rangeland
 - b. Wetland
 - c. Farmland**
 - d. Woodland
13. A way to protect lakes, ponds, and pothole habitats.
- a. Use deflectors to create natural pools.
 - b. Fence shoreline to control livestock grazing and watering.**
 - c. Control water levels.
 - d. Pile brush near the water's edge.
14. A component of river and stream habitats is riffles: Riffles is:
- a. A continuous flow of water with moderate spring runoff at best.
 - b. A certain amount of water needed to maintain stream habitat.
 - c. An area near riverbanks that provides a breeding ground for insects used as food for fish.
 - d. A shallow area in a stream that causes broken water.**
15. An ideal wetland is _____ open water and _____ marsh.
- a. one-half; one-half
 - b. one-third; two-thirds**
 - c. two-thirds; one-third
 - d. one-fourth; three-fourths
16. Release cut is:
- a. Preferred by large numbers of wildlife.
 - b. Thinning of old shrub growth to allow new growth.**
 - c. Removal of dead trees and brush.
 - d. An area of the forest that does not support trees.

Review—Answer Key

17. The _____ layer of a rangeland habitat includes short, mid, and tall grass species.
- a. subsurface
 - b. midstory
 - c. canopy
 - d. **surface**
18. A component of a farmland habitat.
- a. **Shelterbelts**
 - b. Landscape areas and lawns
 - c. Forest openings
 - d. Potholes, playa lakes, and marsh
19. One way to protect urban habitats.
- a. Fence to protect from wildlife grazing and watering.
 - b. **Provide bird houses, feeders, and baths.**
 - c. Seed marginal lands to grasses.
 - d. Restrict clean mowing of pastures and fence rows.

Teacher Supplement 1—Construct Nesting Sites

Name _____ Attempt Number _____

Date _____ Overall Rating _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Student actively took part in project	_____
• Nesting facilities built and distributed	_____
• Nesting sites observed/photographed	_____
• Worked cooperatively with others to reach a common goal	_____
• Project summary was thorough and well written	_____

Basic Skills



Reading



Writing



Science

Oral
Communication

Interpersonal

Critical
Thinking

Technology

Introduction

Throughout North America a number of birds, fish, and mammals require nesting sites that have become scarce because of development, timber clearing, or other destruction of habitat. Some of these include the wood duck, bluebird, various bats, pond fish, etc. This assignment will allow you to study a given member of the wildlife population in your area, and build and distribute nesting facilities for that species.

Instructions

Before beginning this activity, your instructor will divide the class into teams of 3-4 students. As a team, assign specific tasks to each team member so that everyone has an equal opportunity to contribute to this activity. Construct nesting sites for your chosen species. Then, as a class, distribute the completed nesting facilities in and around your community. Each team must select one of the project sites and observe how the nesting facilities are being used as part of the wildlife habitat. Project summaries should be submitted by each team and team members should be prepared to discuss findings in class.

Your instructor will observe individual and group activities and rate your performance using the evaluation criteria.

Tools,
Equipment,
and Materials

- Plans or kits for nesting facilities
- Materials as specified on plans
- Basic tool kit
- Camera, flash attachment, and film

Teacher Supplement 1

Procedure

- ☐ 1. Consult with wildlife conservation officials or wildlife biologists in your state to determine a species that may be aided by increased numbers of nesting sites.
- ☐ 2. Obtain plans or kits for such nesting or resting facilities and build a number of these (according to plans) to be distributed in your area.
- ☐ 3. Distribute the nesting and/or resting facilities in areas most likely to attract increased numbers of your chosen species.
- ☐ 4. Observe the nesting sites and photograph the occupants that take up residence in your provided habitat.
- ☐ 5. Prepare a two-page summary of the project (as a team), including the following:
 - Name of chosen species
 - Reason why particular species selected
 - Type of nesting/resting facility constructed
 - Locations of nesting sites
 - Photographs of species that reside in nesting facility
 - Benefits of project to wildlife habitat improvement

Evaluator's Comments: _____

Teacher Supplement 2—Determine the Carrying Capacity of a Pond

Name _____ Overall Rating _____

Evaluation Criteria	Rating
• Calculations are accurate	_____
• Assignment was completed on time	_____

Basic Skills



Reading



Mathematics



Science

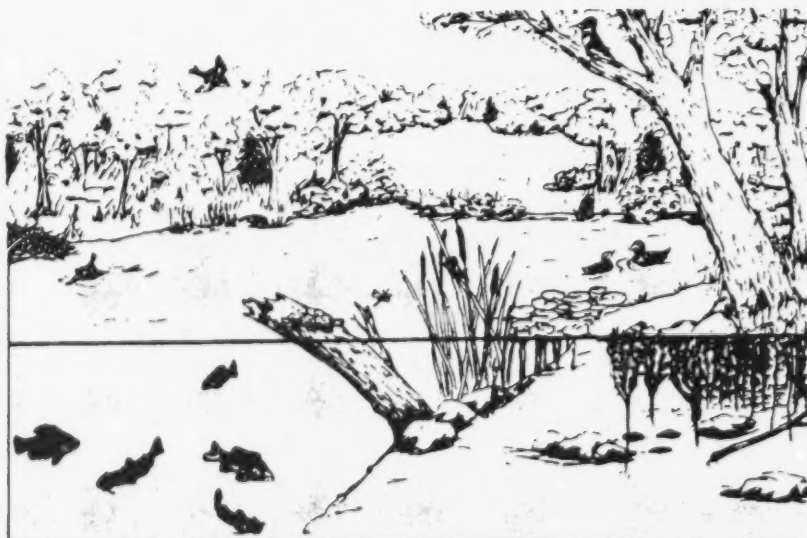
Introduction

Every pond has a physical limitation of the amount of biotic activity it can sustain. This limit is fixed, regardless of the species living in the pond. So, through this exercise you will gain an awareness of the differing amounts of certain species a given pond will sustain.

Directions

Using the information provided, determine the amount of each fish that a pond might support.

Figure 1



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Teacher Supplement 2

The bluegill population that this pond can support is 200 lbs. per acre. Consider that the amount of food, cover, and space remain the same.

1. The same pond can support only $\frac{1}{4}$ the amount of bass. The capacity of the pond for bass is _____ pounds per acre.
2. The same pond can support only $\frac{1}{20}$ the amount of northern pike. The capacity of the pond for northern pike is _____ pounds per acre.
3. Theoretically, the pond can support more, but smaller bluegills. If the pond supports two hundred 1-pound bluegills, it should be able to support _____ $\frac{1}{2}$ -pound bluegills.

Teacher Supplement 3—Analyze Current Reports Concerning Wildlife Habitats

Name _____

Overall Rating _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Minimum of five current articles collected	_____
• Content is relevant and well organized	_____
• Report is neat and legible	_____
• Assignment was completed on time	_____

Basic Skills



Reading



Writing



Science



Critical Thinking



Technology

Introduction

Throughout this study of natural resources, you will be asked to research and report on a variety of subjects according to material being covered in the specific units of instruction you are studying. In this assignment you will be researching material relevant to wildlife habitats.

Directions

Using books, magazines, and newspapers from your local or school library, and articles found in on-line computer services, clip and save at least five articles dealing with public controversy over wildlife habitats and competing uses of the land in question. Try to find articles representing the various interest groups involved in the controversy.

After reading the articles, write a report detailing the controversy as it has been reported and write a description of how you would attempt to solve the controversy if you were assigned that duty. In your solution, try to accommodate the various interest groups involved.

Your instructor will provide you with guidelines explaining the format of the finished report. This assignment will be collected and retained in a portfolio that will become a record of the progress you have made in your study of natural resources.

Note: For help in finding recent periodicals concerning the public controversy over wildlife habitats and land use, consult the *Reader's Guide* in your school or community library.

Answers to Assignment Sheets**Assignment
Sheet 1****Lay Out and Identify Ways to Improve a Local Habitat**

Student performance should be evaluated according to the criteria listed on the assignment sheet.

**Assignment
Sheet 2****Develop a Management Plan for a Farm Pond for Sport Fishing**

Student performance should be evaluated according to the criteria listed on the assignment sheet.

**Assignment
Sheet 3****Identify Ways to Improve a Wetland Habitat**

1. Provide a dependable water supply
2. Control water levels
3. Protect from too much grazing that can destroy valuable food and cover
4. In wetlands that are overgrown, provide open areas by removing vegetation in 50-foot wide strips

**Assignment
Sheet 4****Determine the Carrying Capacity of a Rangeland Habitat**

1. 100
2. 200
3. 300
4. 400
5. 400

**Assignment
Sheet 5****Survey Wildlife Foods**

Student performance should be evaluated according to the criteria listed on the assignment sheet.

**Assignment
Sheet 6****Survey Non-Game Birds at a Feeding Station**

Student performance should be evaluated according to the criteria listed on the assignment sheet.

Written Test

Name _____

Date _____ Score _____

Objective 1

Match terms related to wildlife habitats with their definitions. Write the corresponding numbers in the blanks provided.

- | | |
|----------------------|---------------------|
| 1. Browse | 7. Home range |
| 2. Canopy | 8. Limiting factors |
| 3. Carrying capacity | 9. Mast |
| 4. Edge | 10. Plankton |
| 5. Habitat | 11. Release cut |
| 6. Habitat component | 12. Riffles |

- _____ a. Thinning of old shrub growth to allow new growth
- _____ b. The leaves, shoots, and twigs of trees and shrubs available for animal consumption
- _____ c. The area where a plant or animal naturally lives and grows
- _____ d. Nuts of trees and shrubs which are used as food by animals
- _____ e. Factors that restrict the population potential of a species
- _____ f. A factor in a habitat that supports the life of a wildlife animal
- _____ g. A shallow area in a stream that causes broken water
- _____ h. Suspended, floating, microscopic plants and animals in the water
- _____ i. The maximum number of animals that an area can support
- _____ j. The area in which an animal lives and travels
- _____ k. Leaf area of the woodland
- _____ l. Transitional zone where one cover type ends and another begins

Written Test

Objective 2

Match the components of a habitat with their descriptions. Write the corresponding numbers in the blanks provided.

1. Cover 2. Food 3. Space 4. Water

- _____ a. Provides nutrients for growth, maintenance, and reproduction
- _____ b. Needed for blood composition to regulate body temperature, and to provide nutrient transport throughout the body
- _____ c. Amount of area that an animal uses to locate its basic requirements
- _____ d. Vegetation and other material providing protection for the animal

Objective 3

List the objectives of wildlife habitat management.

- a. _____
- _____
- b. _____
- _____

Objective 4

Select true statements concerning habitat management principles by placing an "X" in the blanks next to the true statements.

- _____ a. Wildlife research helps to determine the habitat requirements of specific wildlife.
- _____ b. Most species require the same type of habitat.
- _____ c. When the basic components of a habitat are abundant and ideal, the animal species will reach its maximum (biotic) potential.
- _____ d. Environmental factors limit the potential of an animal species population.
- _____ e. All land has the same carrying capacity for all animal species.
- _____ f. Surplus animals always die.
- _____ g. When habitat conditions change, the type and amount of wildlife present remain the same.
- _____ h. Wildlife species can be maintained only by moving them to more suitable habitats.

Written Test

Objective 5

Match common tools and techniques of habitat improvement with their uses. Write the corresponding numbers in the blanks provided.

- | | | |
|---------------|--------------------|-----------------------|
| 1. Chemicals | 5. Farm ponds | 9. Nesting structures |
| 2. Dams | 6. Fences | 10. Shelterbelts |
| 3. Deflectors | 7. Food plots | |
| 4. Edges | 8. Heavy equipment | |

- _____ a. Provide a habitat for fish as well as a watering place for other wildlife
- _____ b. Used to change the composition of the water or soil either to encourage or discourage various plant and animal species
- _____ c. Provide nesting places for species whose natural habitat has been damaged
- _____ d. Established to provide a change between types of cover
- _____ e. Planted to provide food and cover habitat
- _____ f. Used to protect water and its bank from contamination or damage by domestic animals
- _____ g. Used to control the direction of stream flow

Objective 6

Classify actions taken to improve wildlife habitats according to those that would improve food, water, or cover components. Place the following symbols next to the appropriate actions:

- F—Food improvements
- W—Water improvements
- C—Cover improvements

- _____ a. Deepen existing water-holding basins
- _____ b. Build dams
- _____ c. Provide artificial nest structures
- _____ d. Build artificial roosts or reefs
- _____ e. Increase mast or fruit production
- _____ f. Plant plots of grasses and legumes
- _____ g. Protect from excessive grazing, fires, and mowing
- _____ h. Add tanks, troughs, or wells
- _____ i. Maintain existing dens or nesting trees
- _____ j. Create potholes

Written Test

Objective 7

Select from the following list causes of habitat destruction by placing an "X" in the blanks next to the true statements.

- _____ a. Riffles
- _____ b. Overgrazing
- _____ c. Potholes
- _____ d. Construction
- _____ e. Water temperature
- _____ f. Recreational activities
- _____ g. Roads
- _____ h. Chemicals

Objective 8

Match types of wildlife habitats with their descriptions. Write the corresponding numbers in the blanks provided.

- | | |
|-------------------------------|-------------|
| 1. Farmland | 5. Urban |
| 2. Lakes, ponds, and potholes | 6. Wetland |
| 3. Rangeland | 7. Woodland |
| 4. Rivers and streams | |

- _____ a. Land used for agricultural practices
- _____ b. Land where the water table is usually at or near the surface or the land is covered by shallow water
- _____ c. Land used primarily for growing trees and shrubs
- _____ d. Bodies of running water
- _____ e. Land predominantly occupied by man-made structures used for residential, commercial, and industrial purposes
- _____ f. Land where natural vegetation is mostly grasses, forbs, and shrubs
- _____ g. Bodies of still water

Written Test

Objective 9

Complete the following statements concerning lakes, ponds, and pothole habitats by circling or underlining the correct words.

- a. The (shallow) (deep) water supports plankton and carnivorous fish.
- b. The (shallow) (deep) water contains aquatic vegetation and diverse aquatic populations.
- c. Ways to protect these habitats include the following:
 - (1) Fence shoreline to control (livestock) (birds) from using it for watering.
 - (2) Control erosion in the (watershed) (mountains).
 - (3) Reduce sediment draining into the lake by providing a sediment (filter) (basin) for all feeder streams.
 - (4) Control weeds in (shallow) (deep) areas.

Objective 10

Select true statements concerning river and stream habitats by placing an "X" in the blanks next to the true statements.

- _____ a. The best streamflow pattern is an intermittent flow of water with heavy spring runoff.
- _____ b. A certain amount of water is needed to maintain stream habitat.
- _____ c. Eroding streambanks allow sediment to ruin the streambed.
- _____ d. Riffles provide food and spawning areas for fish, and hunting areas for predators such as racoons and bears.
- _____ e. Riparian areas are breeding areas for pests and should be chemically destroyed.
- _____ f. Cooler temperatures allow less dissolved oxygen for fish.
- _____ g. Fence to protect these habitats from livestock grazing and watering.

Written Test

Objective 11

Complete the following statements concerning wetland habitats by circling or underlining the correct answers.

- a. The high concentration of nutrients in wetlands helps to (increase) (decrease) the productivity of vegetation.
- b. Larger wetland areas tend to provide (more) (less) diverse habitat for more types of wildlife.
- c. Protect area from too (little) (much) grazing that can destroy valuable food and cover.
- d. In wetlands that are overgrown, provide open areas by removing vegetation in (50) (100) foot wide strips.

Objective 12

Complete the following statements concerning woodland habitats by circling or underlining the correct answers.

- a. Edges are (avoided) (preferred) by large numbers of wildlife.
- b. Dead or partly dead trees are called (snags) (stumps).
- c. Areas that do not support trees but provide a source of diversity within the forest are called (canopies) (openings).
- d. To protect these habitats,
 - (1) Overgrazing should be (avoided) (allowed).
 - (2) Brush should be (piled near edge) (disposed of).

Objective 13

Select true statements concerning rangeland habitats by placing an "X" in the blanks next to the true statements.

- _____ a. The subsurface layer includes the area suitable for burrow or tunnel construction.
- _____ b. The midstory layer includes short, mid, and tall grass species.
- _____ c. Rangelands should be protected from unwanted fires.
- _____ d. Allow free grazing in marshy rangeland.
- _____ e. Clear the land of all brush and shrubs.
- _____ f. Build ponds for watering.

Written Test

Objective 14

Select true statements concerning farmland habitats by placing an "X" in the blanks next to the true statements.

- ☐ a. Components of the farmland habitat include cropland, pasture, and woodland.
- ☐ b. Allow wildlife areas to be grazed by domestic animals.
- ☐ c. Seed marginal lands to grasses.
- ☐ d. Drain farm ponds.
- ☐ e. Allow overgrazing of pastures.
- ☐ f. Restrict clean mowing of pastures and fence rows.

Objective 15

Select true statements concerning urban habitats by placing an "X" in the blanks next to the true statements.

- ☐ a. The basic components of an urban habitat include buildings, utilities, transportation, people, and pets.
- ☐ b. One way to protect these habitats is to remove trees and shrubs.
- ☐ c. Steady water sources should be provided.

*Permission to duplicate this test is granted.

Written Test—Answer Key

Objective 1

Match terms related to wildlife habitats with their definitions. Write the corresponding numbers in the blanks provided.

- | | |
|----------------------|---------------------|
| 1. Browse | 7. Home range |
| 2. Canopy | 8. Limiting factors |
| 3. Carrying capacity | 9. Mast |
| 4. Edge | 10. Plankton |
| 5. Habitat | 11. Release cut |
| 6. Habitat component | 12. Riffles |

- 11 a. Thinning of old shrub growth to allow new growth
- 1 b. The leaves, shoots, and twigs of trees and shrubs available for animal consumption
- 5 c. The area where a plant or animal naturally lives and grows
- 9 d. Nuts of trees and shrubs which are used as food by animals
- 8 e. Factors that restrict the population potential of a species
- 6 f. A factor in a habitat that supports the life of a wildlife animal
- 12 g. A shallow area in a stream that causes broken water
- 10 h. Suspended, floating, microscopic plants and animals in the water
- 3 i. The maximum number of animals that an area can support
- 7 j. The area in which an animal lives and travels
- 2 k. Leaf area of the woodland
- 4 l. Transitional zone where one cover type ends and another begins

Written Test—Answer Key

Objective 2

Match the components of a habitat with their descriptions. Write the corresponding numbers in the blanks provided.

1. Cover 2. Food 3. Space 4. Water

- 2 a. Provides nutrients for growth, maintenance, and reproduction
 4 b. Needed for blood composition to regulate body temperature, and to provide nutrient transport throughout the body
 3 c. Amount of area that an animal uses to locate its basic requirements
 1 d. Vegetation and other material providing protection for the animal

Objective 3

List the objectives of wildlife habitat management.

Any order:

- a. To maintain a quality habitat as it exists in a natural ecosystem
b. To improve a habitat where it has deteriorated or where a specific habitat component is lacking

Objective 4

Select true statements concerning habitat management principles by placing an "X" in the blanks next to the true statements.

- X a. Wildlife research helps to determine the habitat requirements of specific wildlife.
 b. Most species require the same type of habitat.
 X c. When the basic components of a habitat are abundant and ideal, the animal species will reach its maximum (biotic) potential.
 X d. Environmental factors limit the potential of an animal species population.
 e. All land has the same carrying capacity for all animal species.
 f. Surplus animals always die.
 g. When habitat conditions change, the type and amount of wildlife present remain the same.
 h. Wildlife species can be maintained only by moving them to more suitable habitats.

Written Test—Answer Key

Objective 5

Match common tools and techniques of habitat improvement with their uses. Write the corresponding numbers in the blanks provided.

- | | | |
|---------------|--------------------|-----------------------|
| 1. Chemicals | 5. Farm ponds | 9. Nesting structures |
| 2. Dams | 6. Fences | 10. Shelterbelts |
| 3. Deflectors | 7. Food plots | |
| 4. Edges | 8. Heavy equipment | |

- 5 a. Provide a habitat for fish as well as a watering place for other wildlife
- 1 b. Used to change the composition of the water or soil either to encourage or discourage various plant and animal species
- 9 c. Provide nesting places for species whose natural habitat has been damaged
- 4 d. Established to provide a change between types of cover
- 7 e. Planted to provide food and cover habitat
- 6 f. Used to protect water and its bank from contamination or damage by domestic animals
- 3 g. Used to control the direction of stream flow

Objective 6

Classify actions taken to improve wildlife habitats according to those that would improve food, water, or cover components. Place the following symbols next to the appropriate actions:

- F—Food improvements
- W—Water improvements
- C—Cover improvements

- W a. Deepen existing water-holding basins
- W b. Build dams
- C c. Provide artificial nest structures
- C d. Build artificial roosts or reefs
- F e. Increase mast or fruit production
- F f. Plant plots of grasses and legumes
- C g. Protect from excessive grazing, fires, and mowing
- W h. Add tanks, troughs, or wells
- C i. Maintain existing dens or nesting trees
- W j. Create potholes

Written Test—Answer Key

Objective 7

Select from the following list causes of habitat destruction by placing an "X" in the blanks next to the true statements.

- _____ a. Riffles
- X b. Overgrazing
- _____ c. Potholes
- X d. Construction
- _____ e. Water temperature
- X f. Recreational activities
- X g. Roads
- X h. Chemicals

Objective 8

Match types of wildlife habitats with their descriptions. Write the corresponding numbers in the blanks provided.

- | | |
|-------------------------------|-------------|
| 1. Farmland | 5. Urban |
| 2. Lakes, ponds, and potholes | 6. Wetland |
| 3. Rangeland | 7. Woodland |
| 4. Rivers and streams | |

- 1 a. Land used for agricultural practices
- 6 b. Land where the water table is usually at or near the surface or the land is covered by shallow water
- 7 c. Land used primarily for growing trees and shrubs
- 4 d. Bodies of running water
- 5 e. Land predominantly occupied by man-made structures used for residential, commercial, and industrial purposes
- 3 f. Land where natural vegetation is mostly grasses, forbs, and shrubs
- 2 g. Bodies of still water

Written Test—Answer Key

Objective 9

Complete the following statements concerning lakes, ponds, and pothole habitats by circling or underlining the correct words.

- a. The (shallow) **(deep)** water supports plankton and carnivorous fish.
- b. The **(shallow)** (deep) water contains aquatic vegetation and diverse aquatic populations.
- c. Ways to protect these habitats include the following:
 - (1) Fence shoreline to control **(livestock)** (birds) from using it for watering.
 - (2) Control erosion in the **(watershed)** (mountains).
 - (3) Reduce sediment draining into the lake by providing a sediment (filter) **(basin)** for all feeder streams.
 - (4) Control weeds in **(shallow)** (deep) areas.

Objective 10

Select true statements concerning river and stream habitats by placing an "X" in the blanks next to the true statements.

- ☐ a. The best streamflow pattern is an intermittent flow of water with heavy spring runoff.
- ☒ b. A certain amount of water is needed to maintain stream habitat.
- ☒ c. Eroding streambanks allow sediment to ruin the streambed.
- ☒ d. Riffles provide food and spawning areas for fish, and hunting areas for predators such as racoons and bears.
- ☐ e. Riparian areas are breeding areas for pests and should be chemically destroyed.
- ☐ f. Cooler temperatures allow less dissolved oxygen for fish.
- ☒ g. Fence to protect these habitats from livestock grazing and watering.

Written Test—Answer Key

Objective 11

Complete the following statements concerning wetland habitats by circling or underlining the correct answers.

- a. The high concentration of nutrients in wetlands helps to **(increase)** (decrease) the productivity of vegetation.
- b. Larger wetland areas tend to provide **(more)** (less) diverse habitat for more types of wildlife.
- c. Protect area from too (little) **(much)** grazing that can destroy valuable food and cover.
- d. In wetlands that are overgrown, provide open areas by removing vegetation in **(50)** (100) foot wide strips.

Objective 12

Complete the following statements concerning woodland habitats by circling or underlining the correct answers.

- a. Edges are (avoided) **(preferred)** by large numbers of wildlife.
- b. Dead or partly dead trees are called **(snags)** (stumps).
- c. Areas that do not support trees but provide a source of diversity within the forest are called (canopies) **(openings)**.
- d. To protect these habitats,
 - (1) Overgrazing should be **(avoided)** (allowed).
 - (2) Brush should be **(piled near edge)** (disposed of).

Objective 13

Select true statements concerning rangeland habitats by placing an "X" in the blanks next to the true statements.

- ☒ a. The subsurface layer includes the area suitable for burrow or tunnel construction.
- ☐ b. The midstory layer includes short, mid, and tall grass species.
- ☒ c. Rangelands should be protected from unwanted fires.
- ☐ d. Allow free grazing in marshy rangeland.
- ☐ e. Clear the land of all brush and shrubs.
- ☒ f. Build ponds for watering.

Written Test—Answer Key

Objective 14

Select true statements concerning farmland habitats by placing an "X" in the blanks next to the true statements.

- ☐ a. Components of the farmland habitat include cropland, pasture, and woodland.
- ☐ b. Allow wildlife areas to be grazed by domestic animals.
- ☒ c. Seed marginal lands to grasses.
- ☐ d. Drain farm ponds.
- ☐ e. Allow overgrazing of pastures.
- ☒ f. Restrict clean mowing of pastures and fence rows.

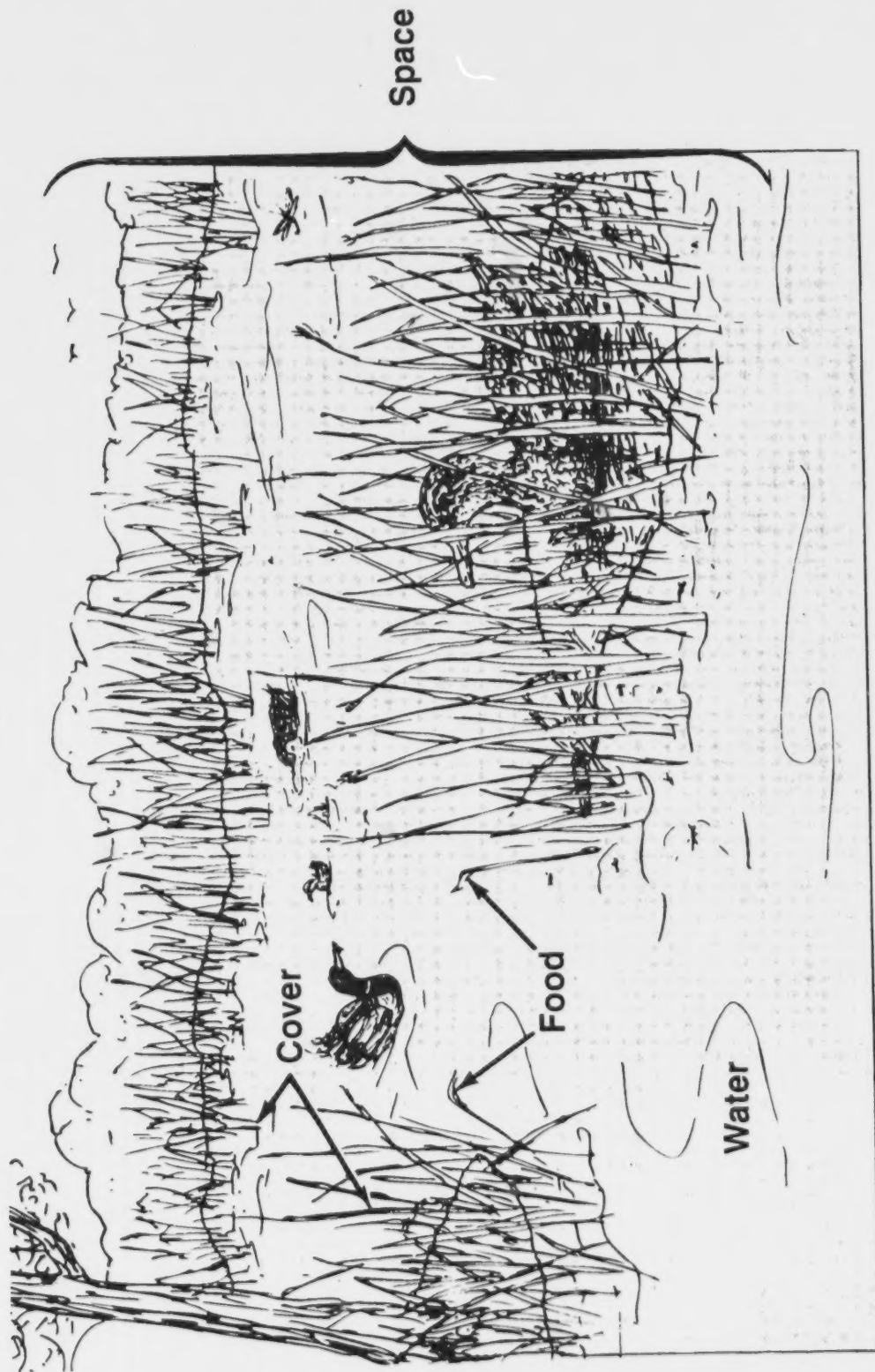
Objective 15

Select true statements concerning urban habitats by placing an "X" in the blanks next to the true statements.

- ☒ a. The basic components of an urban habitat include buildings, utilities, transportation, people, and pets.
- ☐ b. One way to protect these habitats is to remove trees and shrubs.
- ☒ c. Steady water sources should be provided.

*Permission to duplicate this test is granted.

Components of a Habitat

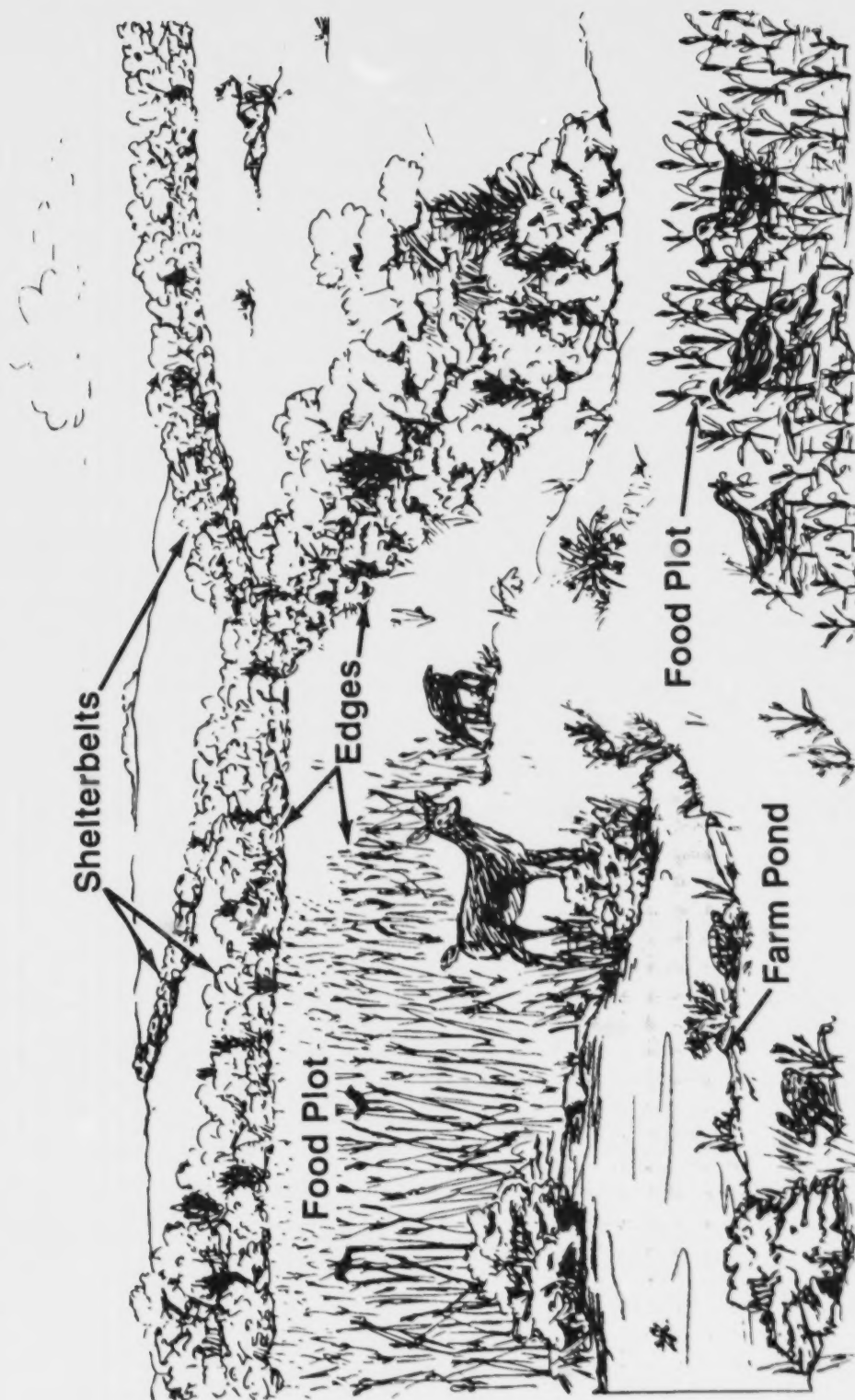


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TM 1

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Habitat Improvement

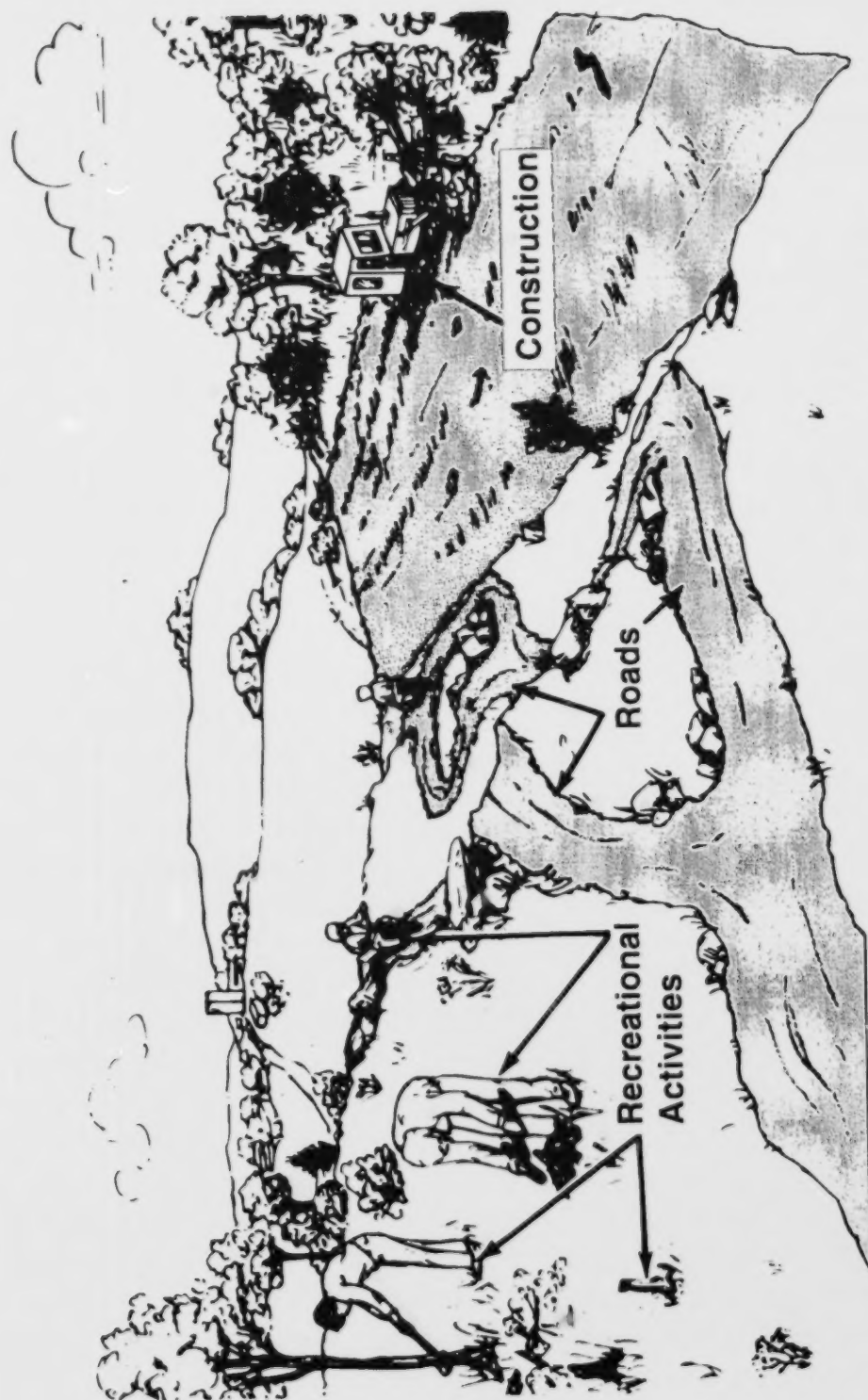


Habitat Improvement (continued)



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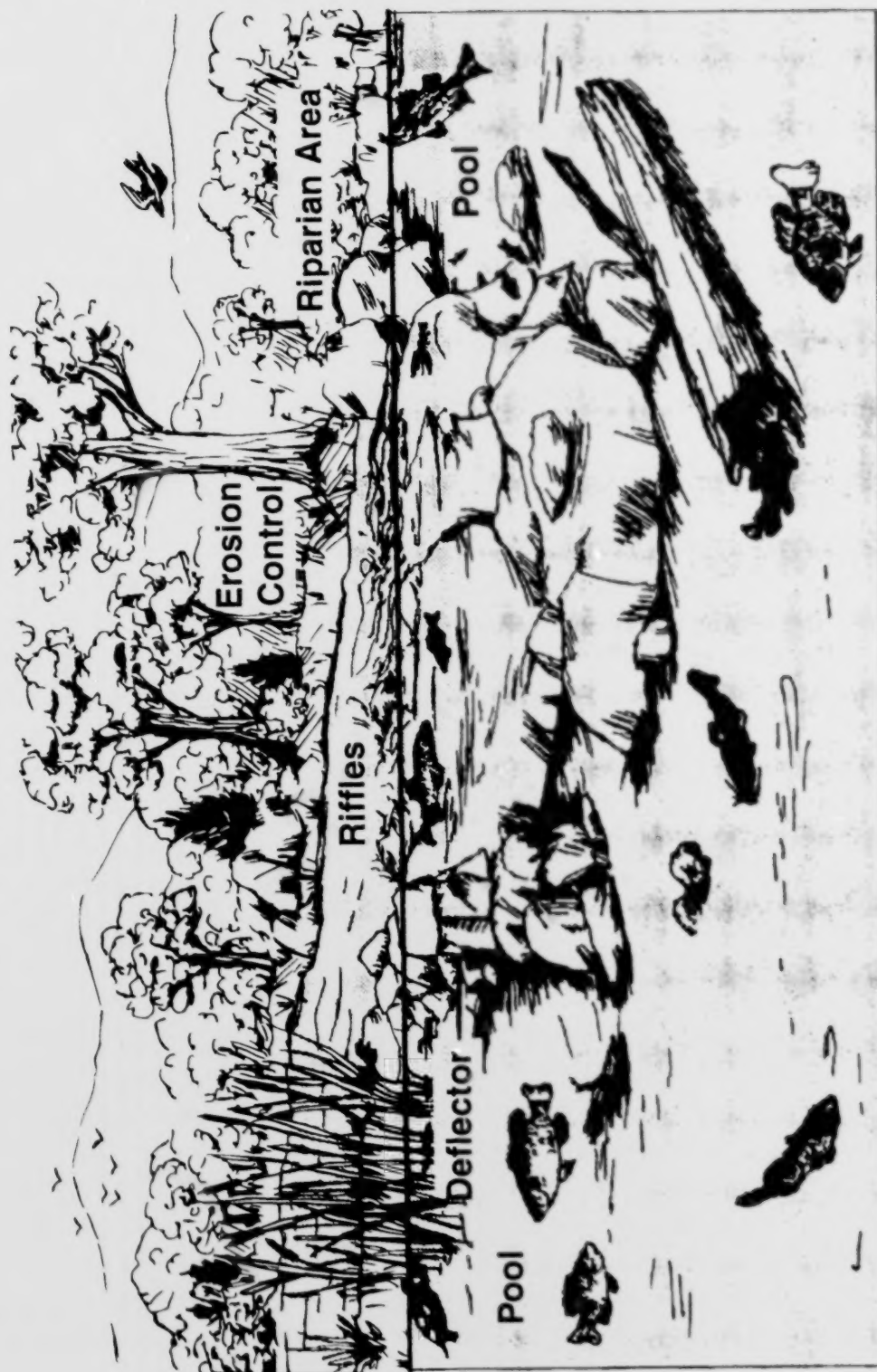
Habitat Destruction



Lakes, Ponds, and Pothole Habitats



River and Stream Habitats



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Wetland Habitat



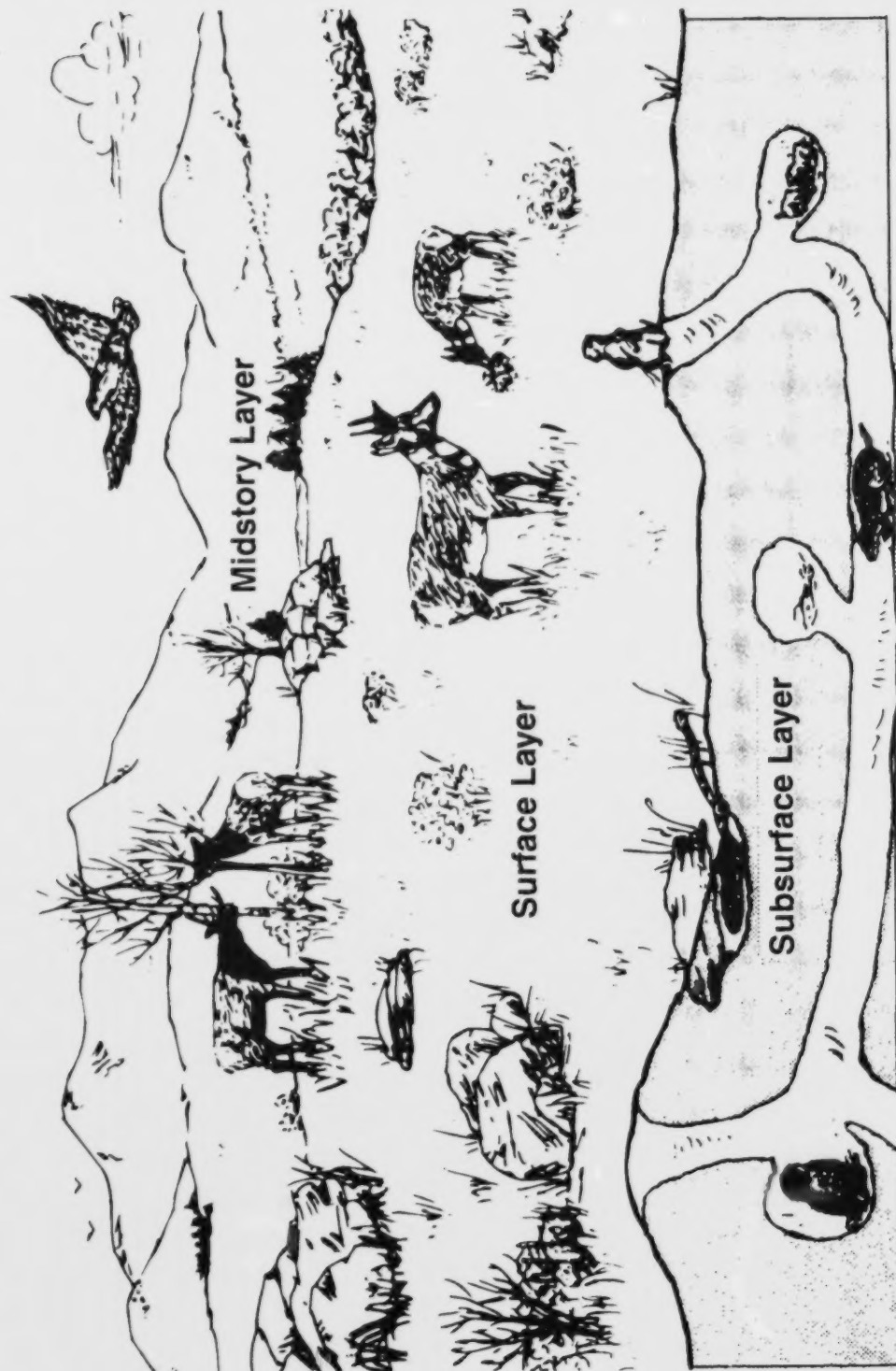
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TM 7

Woodland Habitat

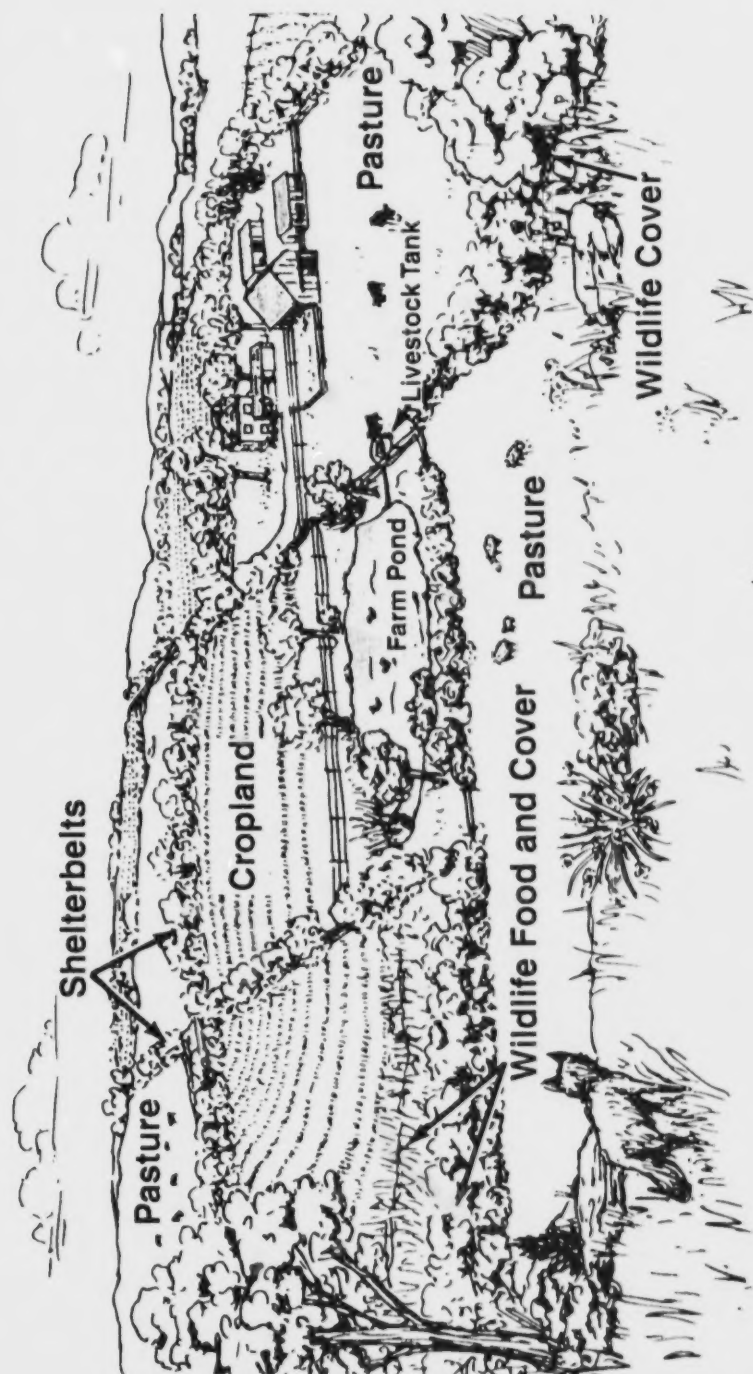


Rangeland Habitat

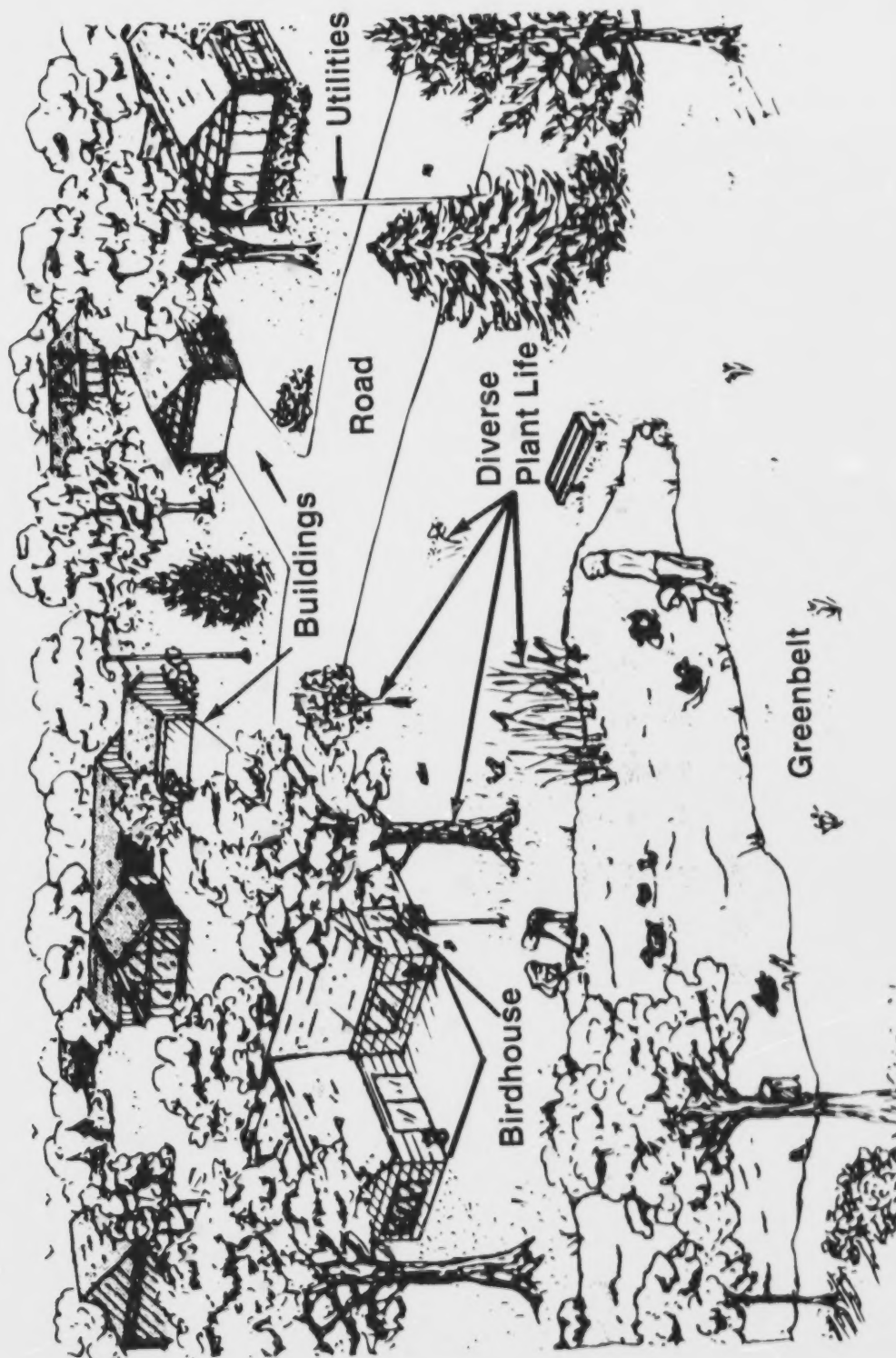


BEST COPY AVAILABLE TM 9

Farmland Habitat



Urban Habitat



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* Assignment Sheets are located in the Student Workbook.

Instructional
Plan

Suggested Activities

Preparation

- Review the objective sheet. Study the specific objectives to determine the order in which you will present the objectives.
- Review the suggested lesson plan. The plan identifies an order for instruction to take place. Each "day" represents a 50-minute class period. The plan is designed to cover the specific objectives over a 15-day period. Additional days and/or activities may be added. Note: You may want to change days to specific dates. Example: Day 1 may become Monday, May 1, Day 2 = Tuesday, May 2, and so forth.) You will want to localize, supplement, and personalize the plan to fit your situation.
- Review the teaching suggestions included in this instructional plan section to plan classroom activities. Also note the suggestions for supplemental resources.
- Plan your delivery/application to take advantage of student learning styles and to accommodate special-needs students.
- Obtain films, videotapes, and other materials to supplement instruction of this unit. See "Resources Used in Developing This Unit" and "Suggested Supplemental Resources" for more information.
- Make transparencies from the transparency masters included in this unit. These appear in the teacher edition only and should be used with objectives as indicated below.

TM 1—Why Do People Enjoy These Activities? (Objective 2)

TM 2—Why Do People Enjoy These Activities? (Continued)
(Objective 2)

TM 3—Why Do People Enjoy These Activities? (Continued)
(Objective 2)

TM 4—Career Opportunities in Outdoor Recreation (Objective 9)

- Use the following teaching supplements to enhance your delivery and application activities.

TS 1—Develop a Historical Presentation for Visitors to Your Area

TS 2—Friends in the Night Sky

TS 3—Locate Constellations in the Night Sky

TS 4—The Dakota Fire Hole

TS 5—Build a Wood-Conserving Dakota Fire Hole

Suggested Activities

- Select teacher components (written test, unit review, teacher supplements) you want to distribute to your students. Copy and prepare these components for distribution.
- Prepare classroom. Put up posters and charts and display articles and other references related to the objectives of this unit.

Delivery and Application

- Discuss unit and specific objectives.
- Discuss information sheets. Implement teaching plan to localize, supplement, and personalize the unit. Reinforce basic academic and workplace skills when applicable.
- Discuss the assignment sheets. Review with students the criteria for evaluation of each of these activities.

Teaching Suggestions

The skill areas appearing in bold-face type in the teaching suggestions refer to the academic and workplace skills identified in *What Work Requires of Schools: A SCANS Report for America 2000* and *Workplace Basics: The Skills Employers Want*. These have been adapted by MAVCC.

- Invite guest speakers to discuss with the class their occupation in outdoor recreation or natural resources, skills, and education required, and possibly demonstrates a specific skill or safety procedure associated with their occupation. (**Listening; career awareness**)
- Visit a park or recreation area and tour the facility with a park manager, ranger, or park employee. You might tie this activity with Assignment Sheets 3, 4, 5, and 8. (**Listening; speaking; acquiring technical information**)
- Have student "adopt" a local park as a class or student organization; and have them assist in making improvements. (**Leadership; teamwork; problem solving**)
- If facilities and equipment are available, teach students to:
 - Maintain grounds with power mower, string trimmer, farm tractor, and brush hog
 - Saddle and care for a horse
 - Set up a camp site
 - Paddle a canoe
 - Prepare for a hiking trip
 - Use a compass (Orienteering)
 - Clean up a park area and facilities

Suggested Activities

- Arrange an overnight class/field camping trip where skills such as orienteering, fire building, and star and constellation identification can be taught and tested. Seek sufficient adult coworkers to accompany the class and expedite an overnight trek into natural surroundings. **(Organizational effectiveness; responsibility; self-esteem; teamwork; knowing how to learn; acquiring and applying what has been learned to a specific task)**
- Investigate birding using resources of the internet. Here are a few web sites to use in beginning the study:

U.S. Fish and Wildlife Service — www.fws.gov/
Birdnet — www.nmnh.si.edu/BIRDNET/
Birder and Birding — www.birder.com/
Wildlife Watching Supplies — www.wildlifewatchingsupplies.co.uk/
Patuxent Bird Identification — www.mbr.nbs.gov/bbs/ident.html
- Contact a local game warden or state wildlife conservation department and obtain copies of regulations about hunting, fishing, and trapping in your state.
- Arrange for an experienced sport fisher to demonstrate methods and procedures in sport fishing. This may include tackle selection, fishing procedures, handling fish, and dressing fish. **(Listening; acquiring and applying what has been learned to a specific task)**
- Review Unit 1 – Outdoor Safety and First Aid to reemphasize the need for safety.

Evaluation

- Give and evaluate Outdoor Recreation Review.
- Copy written test and give to students as pretest.
- Evaluate assignment sheets. See the evaluation criteria listed at the top of each assignment sheet and the component "Answers to Assignment Sheets." Evaluation may be localized, personalized, or individualized to fit your situation.
- Give and evaluate written test. Record student's written test score in your grade book and on the student's competency profile.
- Measure competency gains by comparing written pretest scores with posttest scores.
- Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas of improvement.
- Reteach and retest as required.

Suggested Activities

Resources Used in Developing This Unit	Instructions for Evaluating Student Performance • When the student is ready to perform a specific task, obtain a copy of the assignment sheet which may be found in the student workbook. • Once the student has completed an assignment sheet, evaluate the student's work using the evaluation criteria. If the student's work is unsatisfactory, have the student review the assignment sheet and submit their work for evaluation again. Record the appropriate level of competency on the student's competency profile. • Sample performance evaluation keys have been provided below. Many other keys are available. Select one rating (grading scale) which best fits your program needs. Sample A 4—Skilled—Can perform job with no additional training. 3—Moderately skilled—Has performed job during training program; limited additional training may be required. 2—Limited skill—Has performed job during training program; additional training is required to develop skill. 1—Unskilled—Is familiar with process, but is unable to perform job. 0—No exposure—No information or practice provided during training program. Sample B Yes—Can perform job with no additional training. No—Is unable to perform job satisfactorily. • Encourage students to continue their portfolio. The portfolio should be a record of the student's progress in the study of natural resources. Note: URLs change frequently. Any of the web sites listed may have moved. • Camp, William G. and Thomas B. Daugherty, <i>Managing Our Natural Resources (4th Edition)</i>, Albany, NY: Delmar Publishers, Inc., 2002. www.agriscience.delmar.com • Lee, Jasper S., <i>Natural Resources and Environmental Technology</i>, Danville, IL: Interstate Publishers, Inc., 2000. www.interstatepublishers.com • Porter, Lynn, Jasper S. Lee, Diana L. Turner, and Malcolm Hillian, <i>Environmental Science and Technology (2nd Edition)</i>, Danville, IL: Interstate Publishers, Inc., 2003. www.interstatepublishers.com • Stutzenbaker, Charles D., Brenda J. Schell, Michael K. Swan, Jasper S. Lee, and Jeri Mattics Omernik, <i>Wildlife Management Science and Technology (2nd Edition)</i>, Danville, IL: Interstate Publishers, Inc., 2003.
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Suggested Activities

Suggested Supplemental Resources

- *Outdoor Recreation in the United States: Results from the National Survey on Recreation and the Environment*, USDA Forest Service, August, 1997.
www.srs.fs.usda.gov/trends

Print Media

- Harvey, Mark, *The National Outdoor Leadership School's Wilderness Guide: The Classic Handbook — Illustrated Edition (Revised and Updated)*, Fireside, 1999.
- *Dr. Confer's Outdoor Recreation Resources and Links*, Dr. John Confer, University of Florida, Gainesville, FL. Provides links to federal agencies (Department of Interior, Department of Agriculture, Department of Defense, Department of Commerce, and Department of Transportation) and interagency links.
www.hhp.ufl.edu/rpt/faculty/jconfer/resources/outdoors/NRR—Agencies.htm
- *Wildernet* — a guide to outdoor recreation. Wildernet has a data base of over 40,000 outdoor recreation area and activities. Search by state, by activity, and/or by key word.
www.wildernet.com
- *Yahoo Director Recreation/Outdoors* — Outdoor recreation activities are identified by region and/or category.
<http://dir.yahoo.com/recreation/outdoors>
- Outdoor Industry Association (OIA) — promotes and preserves the human powered outdoor recreation industry.
www.outdoorindustry.org
- Selected links for outdoor recreation:

National Park Service — www.nps.gov
U.S. Fish & Wildlife Service — www.fws.gov
Bureau of Land Management — www.blm.gov
Environmental Protection Agency — www.epa.gov/teachers
U.S. Geological Survey — www.usgs.gov/education
National Biological Information Infrastructure — www.nbii.gov/issues
USDA Forest Service — www.fs.usda.gov

Suggested Lesson Plan

Day 1

Introduction:

- Discuss unit objective and review specific objectives and plan for completing this unit.
- Have students read the introduction and discuss their viewpoints toward outdoor recreation.
- State the objectives for today's lesson.

Delivery and Application

- Discuss Objective 2—Equipment and facilities needed for selected outdoor recreation activities.
- Use TMs 1, 2, and 3 to illustrate and discuss why people enjoy these activities.
- Discuss Objective 3—Skills and licenses needed for outdoor recreation activities.

Closure:

- Review Objective 2.

Evaluation:

- Non-applicable.

Day 2

Introduction:

- Review Objective 3.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 4—Major factors increasing the demand and participation in outdoor recreation.
- Discuss Objective 5—Other factors affecting current and future participation in recreational activities.

Assign Assignment Sheet 1—Interpret Graphs on Future Trends in Outdoor Recreation.

- Discuss the introduction, directions, and evaluation criteria.
- Discuss the statistical graphs.
- Have students complete questions.
- Due at next class.

Closure:

- Review Objective 4.

Evaluation:

- Non-applicable.

Suggested Lesson Plan

Day 3

Introduction:

- Review Objective 5.
- Review progress on Assignment Sheet 1.
- State the objectives for today's lesson.

Delivery and Application:

- Provide supervised study for completion of Assignment Sheet 1.
- Turn in Assignment Sheet 1.
- Assign Assignment Sheet 2—Identify Outdoor Recreation Activities and Facilities Available Locally.
 - Discuss introduction, directions, and evaluation criteria.
 - Assist students with identification of local outdoor recreation and facilities. (Brainstorm)
 - Have students complete facilities available for each activity.
 - Have each student answer the questions.
 - Turn in Assignment Sheet 2.

Closure:

- Review discussion on Assignment Sheet 2.

Evaluation:

- Evaluate each student's performance on Assignment Sheets 1 and 2 according to criteria stated on each assignment sheet.
- Record student's grade for Assignment Sheet 1 in grade book.
- Record student's grade for Assignment Sheet 2 in grade book.
- Record the appropriate level of competency for each assignment sheet on each student's competency profile.

Day 4

Introduction:

- Return Assignment Sheet 1. Discuss, if necessary.
- Return Assignment Sheet 2. Discuss, if necessary.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Objective 6—Considerations when selecting an outdoor recreation area.
- Discuss Objective 7—Reasons why people participate in outdoor recreation.
- Assign Assignment Sheet 3—Evaluate a Local Outdoor Recreation Site.
 - Discuss introduction, directions and evaluation criteria.
 - Review possible sites to evaluate.
 - Suggestion: Assure that all local sites will be evaluated.
 - Suggested due date for Day 8.

Suggested Lesson Plan

	• Assign Assignment Sheet 4—Make a Presentation About an Outdoor Recreation Activity — Discuss introduction, directions and evaluation criteria. — Review possible outdoor activities. Make sure all activities in Objective 2 are covered. May want to check out Yahoo web site for more activities. — Review presentation suggestions. — Begin presentations on Day 6. Closure: • Review Objective 6. Evaluation: • Non-applicable.
Day 5	Introduction: • Review Objective 7. • Review progress on Assignment Sheets 3 and 4. • State the objectives for today's lesson. Delivery and Application: Discuss Objective 8—Agencies responsible for public lands, recreation areas, and employment in outdoor recreation. • Provide supervised study for research for Assignment Sheet 4 presentation. Closure: • Review Objective 8. Evaluation: • Non-applicable.
Day 6	Introduction: • Review progress on Assignment Sheets 3 and 4. • State the objectives for today's lesson. Delivery and Application: • Begin Assignment Sheet 4 presentations. Closure: • Review presentations. Evaluation: • Non-applicable.

Suggested Lesson Plan

Day 7

Introduction:

- Review progress on Assignment Sheets 3 and 4.
- State the objectives for today's lesson.

Delivery and Application:

- Continue Assignment Sheet 4 presentations.

Closure:

- Review presentations.
- Remind students Assignment Sheet 3 is due in next class.

Evaluation:

- Non-applicable.

Day 8

Introduction:

- Review progress on Assignment Sheets 3 and 4.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss findings for Assignment Sheet 3.
- Turn in Assignment Sheet 3.
- Complete Assignment Sheet 4 presentations.
- Assign Assignment Sheet 5—Plan and Design a New Outdoor Recreation Area.
 - Discuss introduction, directions, and evaluation criteria.
 - Encourage students to use their imagination and information learned from previous assignment sheets, information sheets, and presentations.
 - Due date Day 11.

Closure:

- Review Assignment Sheet 5.

Evaluation:

- Evaluate each student's performance on Assignment Sheets 3 and 4 according to criteria stated on each assignment sheet.
- Record student's grade for Assignment Sheet 3 in grade book.
- Record student's grade for Assignment Sheet 4 in grade book.
- Record the appropriate level of competency for each assignment sheet on each student's competency profile.

Day 9

Introduction:

- Return Assignment Sheet 3. Discuss, if necessary.
- Return Assignment Sheet 4. Discuss, if necessary.
- Review progress on Assignment Sheet 5.
- State the objectives for today's lesson.

Suggested Lesson Plan

Day 10

Delivery and Application:

- Discuss Objective 9—Employment opportunities in outdoor recreation.
- Use TM 4 to illustrate employment opportunities.
- Discuss Objective 10—Business opportunities in outdoor recreation.
- Provide supervised study for Assignment Sheet 5.

Closure:

- Review Objective 10.

Evaluation:

- Non-applicable.

Introduction:

- Review progress on Assignment Sheet 5.
- Review Objective 9.
- State the objectives for today's lesson.

Delivery and Application:

- Assign Assignment Sheet 8—Explore Career Opportunities in Natural Resources.
 - Discuss introduction, directions, and evaluation criteria.
 - Have students review objectives on occupations in previous units.
 - Review textbook in "Resources Used In Developing This Unit." for chapters on occupations for each area in natural resources.
 - Due date Day 15.
- Provide supervised study for Assignment Sheets 5 and 8.

Closure:

- Review progress on Assignment Sheets 5 and 8.
- Remind students Assignment Sheet 5 is due in next class.

Evaluation:

- Non-applicable.

Day 11

Introduction:

- Review progress on Assignment Sheets 5 and 8.
- State the objectives for today's lesson.

Delivery and Application:

- Have students share their designs and plans for Assignment Sheet 5.
- Turn in Assignment Sheet 5.
- Assign Assignment Sheet 6—Give Accurate, Easy-to-Follow Directions.
 - Discuss introduction, directions, and evaluation criteria.
 - Provide supervised study for completion of assignment sheet.
 - Have student role-play by giving directions to another student.
 - Turn in assignment sheet at end of class.

Closure:

- Review giving accurate, easy-to-follow directions.

Suggested Lesson Plan

Day 12

Evaluation:

- Evaluate each student's performance on Assignment Sheets 5 and 6 according to criteria stated on each assignment sheet.
- Record student's grade for Assignment Sheet 5 in grade book.
- Record student's grade for Assignment Sheet 6 in grade book.
- Record the appropriate level of competency for each assignment sheet on each student's competency profile.

Introduction:

- Return Assignment Sheet 5. Discuss, if necessary.
- Return Assignment Sheet 6. Discuss, if necessary.
- Review progress on Assignment Sheet 8.
- State the objectives for today's lesson.

Delivery and Application:

- Discuss Assignment Sheet 7—Evaluate Conflict Resolution Scenarios.
 - Discuss introduction, directions, and evaluation criteria.
 - Read each scenario, discuss both sides of the conflict, and have each student write their answer to each question on their assignment sheet. (Alternative suggestion: Divide class into five teams. Assign a conflict to each team for resolution. Have teams report back to class.)
 - Turn in Assignment Sheet 7.
- Provide supervised study for Assignment Sheet 8.

Closure:

- Remind students of unit review during next class.
- Remind students of written test on Day 14.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 7 according to criteria stated on assignment sheet.
- Record student's grade for Assignment Sheet 7 in grade book.
- Record the appropriate level of competency for assignment sheet on each student's competency profile

Day 13

Introduction:

- Return Assignment Sheet 7. Discuss, if necessary.
- Review progress on Assignment Sheet 8.
- State the objectives for today's lesson.

Delivery and Application:

- Give Outdoor Recreation Review.
- Provide supervised study for completion of Assignment Sheet 5 and review for written test.

Closure:

- Remind students of written test during next class.

Suggested Lesson Plan

Day 14

Evaluation:

- Evaluate each student's performance on Outdoor Recreation Review according to answer key.
- Record student's unit review grade in grade book.

Introduction:

- Review progress on Assignment Sheet 8
- Return Outdoor Recreation Review and discuss answers.
- Review for written test.
- State the objectives for today's lesson.

Delivery and Application:

- Give written test.
- Provide supervised study for Assignment Sheet 8 for students who have completed written test.

Closure:

- Review expectations for Assignment Sheet 8.

Evaluation:

- Evaluate student performance on written test using answer key.
Note: Develop teaching strategies for students who did not achieve minimum criteria.
- Record written test grade in grade book.
- Record written test score on each student's competency profile.

Day 15

Introduction:

- Return written test and discuss answers.
- Discuss strategies for students who did not achieve minimum criteria on written test.
- State the objectives for today's lesson.

Delivery and Application:

- Have students share their findings from Assignment Sheet 8.
- Discuss opportunities for employment in natural resources in local area.
- Turn in Assignment Sheet 8.

Closure:

- Review unit objectives.
- Review next lesson or completion of course requirements.

Evaluation:

- Evaluate each student's performance on Assignment Sheet 8 according to criteria stated on the assignment sheet.
- Record student's grade for Assignment Sheet 8 in grade book.
- Record the appropriate level of competency for assignment sheet on each student's competency profile
- Return assignment sheet to students at next class.

Outdoor Recreation Review

Name _____

Overall Rating _____

Evaluation Criteria

Rating

- Directions have been followed _____
- Answers indicate serious effort was taken in completing worksheet _____

Introduction

We all enjoy being outdoors, walking in the woods or meadows and experiencing nature. As we look at the outdoor recreational activities at our disposal, the number seems limitless. Between federal, state, and local governments almost any form of outdoor recreation activity we can imagine is available. Understanding the outdoors helps us enjoy being outside even more. It is up to us to preserve this irreplaceable natural recreational resource.

Directions

Answer the following questions concerning outdoor recreation. For help, refer to the information sheets in this unit. Circle the correct response for each question.

1. Outdoor recreation:
 - a. An event or program which trains and refines the mind
 - b. Deals with any activity that a person voluntarily does in the outdoors for enjoyment and satisfaction
 - c. Encourages competition only for sports activities
 - d. Requires active physical participation
2. Equipment needed for hiking.
 - a. Proper clothes, climbing equipment
 - b. Proper shoes and clothing
 - c. Shoes, pack, food, maps
 - d. Private vehicle or bus
3. Equipment needed for boating.
 - a. Life vest, "buddy"
 - b. Skis, boat, ski rope, life vest
 - c. Diving equipment, boat
 - d. Motor or sailboat

Review

4. Facility needed for biking.
 - a. Scenic turn-outs, information signs
 - b. Trails or tracks
 - c. Bike trails, safety signs
 - d. Small open, uncrowded areas
5. Facility needed for picnicking.
 - a. Table, grill, trash disposal, clean, scenic, uncrowded area
 - b. Shaded, scenic area, clean, free of pests
 - c. Natural habitats for birds
 - d. Small open, uncrowded areas
6. An outdoor recreational activity for which a license or permit is needed.
 - a. Sight-seeing
 - b. Hiking
 - c. Fishing
 - d. Water skiing
7. Skills needed for hunting.
 - a. Knowledge of the outdoors, safety
 - b. Balance, technique, endurance
 - c. Knowledge of species and habitats
 - d. Knowledge of equipment, safety
8. The _____ is the principal means of transportation to recreational destinations.
 - a. Airplane
 - b. Bus
 - c. Train
 - d. Automobile
9. As leisure time increases, participation in outdoor recreation _____.
 - a. increases
 - b. decreases
 - c. does not change
 - d. remains constant
10. Disposable personal income:
 - a. Is income spent on outdoor recreation activities.
 - b. Is income above what is needed to buy life's necessities.
 - c. Is income spent on rent and groceries.
 - d. Has increased over the past 20 years.

Review

11. More Americans are retiring at an earlier age. Less than _____ % wait until age 65 to retire.
 - a. 25%
 - b. 40%
 - c. 50%
 - d. 75%
12. _____ is a consideration when selecting an outdoor recreation area.
 - a. Social activity
 - b. Natural beauty
 - c. Stress
 - d. Fitness
13. An example why people choose fitness as a reason to participate in an outdoor recreation activity.
 - a. For relaxation with other people
 - b. To be alone
 - c. To obtain or maintain good health from physical exercise
 - d. To test self endurance, limitations, and character
14. An agency that is not responsible for public lands, recreation areas and employment in outdoor recreation.
 - a. U.S. Fish and Wildlife Service
 - b. U.S. Forest Service
 - c. U.S. National Park Service
 - d. U.S. Department of Energy
15. An occupation in outdoor recreation that deals with enforcement.
 - a. Hunting or fishing guide
 - b. Recreation manager
 - c. Game warden
 - d. Safety instructor
16. Ground care includes:
 - a. Truck drivers or operators of tractors, chain saws, lawn mowers, string trimmers, water pumps, and electric motors.
 - b. Maintaining the sanitary facilities such as garbage, restrooms, pest control, trailer dump facilities, and general cleanliness.
 - c. Control and improvement of wildlife numbers.
 - d. Landscaping, grass trimming, camp site cleaning, trail building, and facility repair.

Review

- 17. An occupation in outdoor recreation that involves equipment operation.
 - a. Sanitation engineer
 - b. Safety instructor
 - c. Tractor driver
 - d. Hiking guide

- 18. A business opportunity in outdoor recreation.
 - a. Park ranger
 - b. Dude ranch
 - c. Truck driver
 - d. Golf pro

Outdoor Recreation Review—Answer Key

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate serious effort was taken in completing worksheet	_____

Directions

Answer the following questions concerning outdoor recreation. For help, refer to the information sheets in this unit. Circle the correct response for each question.

1. Outdoor recreation:
 - a. An event or program which trains and refines the mind
 - b. Deals with any activity that a person voluntarily does in the outdoors for enjoyment and satisfaction
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2. Equipment needed for hiking.
 - a. Proper clothes, climbing equipment
 - b. Proper shoes and clothing
 - c. Shoes, pack, food, maps
 - d. Private vehicle or bus
3. Equipment needed for boating.
 - a. Life vest, "buddy"
 - b. Skis, boat, ski rope, life vest
 - c. Diving equipment, boat
 - d. Motor or sailboat

Review—Answer Key

4. Facility needed for biking.
 - a. Scenic turn-outs, information signs
 - b. Trails or tracks
 - c. Bike trails, safety signs**
 - d. Small open, uncrowded areas
5. Facility needed for picnicking.
 - a. Table, grill, trash disposal, clean, scenic, uncrowded area
 - b. Shaded, scenic area, clean, free of pests**
 - c. Natural habitats for birds
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 - b. Hiking
 - c. Fishing**
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 - a. Knowledge of the outdoors, safety**
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8. The _____ is the principal means of transportation to recreational destinations.
 - a. Airplane
 - b. Bus
 - c. Train
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Review—Answer Key

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 - b. **Natural beauty**
 - c. Stress
 - d. Fitness
13. An example why people choose fitness as a reason to participate in an outdoor recreation activity.
- a. For relaxation with other people
 - b. To be alone
 - c. **To obtain or maintain good health from physical exercise**
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14. An agency that is not responsible for public lands, recreation areas and employment in outdoor recreation.
- a. U.S. Fish and Wildlife Service
 - b. U.S. Forest Service
 - c. U.S. National Park Service
 - d. **U.S. Department of Energy**
15. An occupation in outdoor recreation that deals with enforcement.
- a. Hunting or fishing guide
 - b. Recreation manager
 - c. **Game warden**
 - d. Safety instructor
16. Ground care includes:
- a. Truck drivers or operators of tractors, chain saws, lawn mowers, string trimmers, water pumps, and electric motors.
 - b. Maintaining the sanitary facilities such as garbage, restrooms, pest control, trailer dump facilities, and general cleanliness.
 - c. Control and improvement of wildlife numbers.
 - d. **Landscaping, grass trimming, camp site cleaning, trail building, and facility repair.**

Review—Answer Key

- | | |
|--|---|
| | <p>17. An occupation in outdoor recreation that involves equipment operation.</p> <ul style="list-style-type: none">a. Sanitation engineerb. Safety instructorc. Tractor driverd. Hiking guide <p>18. A business opportunity in outdoor recreation.</p> <ul style="list-style-type: none">a. Park rangerb. Dude ranchc. Truck driverd. Golf pro |
|--|---|

Teacher Supplement 1—Develop a Historical Presentation for Visitors to Your Area

Name _____ Overall Rating _____

Evaluation Criteria	Rating
• Worked cooperatively with others to reach a common goal	_____
• Student displayed serious effort at project and its goal	_____
• Presentation was well-researched, informative, and interesting	_____
• Spoke in a clear, concise manner	_____
• Used appropriate eye contact, gestures, and posture	_____

Basic Skills



Reading



Social Studies



Oral Communication



Interpersonal

Introduction

The history of any locale in the United States can be interesting and educational to people who are from another area. Many people who use recreational vehicles spend a day or two in private and public campgrounds before moving on and never have any idea of the historical significance of the town or area in which they are staying.

In this assignment you will be asked to work in a team to research local historical events and to develop a skit that can be presented to visitors to your area.

Directions

Before beginning this activity, your instructor will divide the class into groups to research local historical events and develop skits about those events.

Visit your local public libraries and museums and talk with members of local historical societies to determine interesting historical incidents that have happened in your town, county, or local interest area. (In areas where RV camps are located near natural attractions or historical sites, incidents which were related to those attractions would be of interest to tourists.)

From your studies of local records, old newspaper accounts, books on local history, and interviews with people who may have "lived" the history of your area, select one event and develop a 15- to 20 minute skit to recreate that event to present to groups of tourists. As a team, determine what responsibilities each member will have in developing and presenting the skit. All team members should be prepared to answer questions after your presentation.

Once your group's presentation is polished, meet with managers of local public and private RV campgrounds and seek their approval to schedule your presentation during evening hours in the playground or store area of their campgrounds. If no campground is available, schedule your presentation for students at your school or a local elementary school.

Teacher Supplement 2—Friends in the Night Sky

Throughout recorded history humans have been fascinated with the stars and other elements of the night sky such as comets, meteors, and the brilliant periodic cycles of Earth's neighboring planets.

A knowledge of the various star arrangements, called constellations, can be a comforting asset on lonely nights, particularly if one is lost or otherwise disoriented in the outdoors.

In the northern hemisphere (anything north of the Equator), all stars appear to revolve in concentric circles around a point called the *north celestial pole*—the heavenly counterpart to the Earth's north pole. For star gazers whose latitude is 40 degrees or more, there are a number of constellations within 40 degrees of the north celestial pole that never set; they belong to a region of the sky known as the *northern circumpolar zone*. The various star arrangements, named in ancient times include the dancing bears *Ursa Major* and *Ursa Minor*, their serpentine companion *Draco*, *Cephus* the king and *Cassiopeia* the queen, a giraffe named *Camelopardalus*, and the northern most part of *Lynx*, a constellation which, to some appears as a big cat's tail (a straight line)—the only part visible as the "cat bathes in the ocean." For outdoor activists this portion of the night time heavens is an important tool for direction finding.

Within the constellation *Ursa Major* is found the most famous starry "land mark," the Big Dipper. This familiar formation of 7 to 8 stars revolves around *Polaris*, the North Star, and serves as a ready directional guide to those at sea or throughout most of the northern hemisphere. If one can find the Big Dipper, then one can surely find *Polaris* (See Figure 1), a star which appears to remain stationary because it is located in the axis of the north celestial pole. As the Earth revolves, *Polaris* appears stationary—always a guide to true north. Using the two end stars of the bowl of the Big Dipper, one can draw an imaginary line upward (in relationship to the dipper's bowl) to a single somewhat dim but solitary star about halfway between the Big Dipper and *Cassiopeia*—*Polaris*. (*Polaris* is the end star in the handle of the Little Dipper (*Ursa Minor*), another constellation shaped similarly to the Big Dipper but much more dim in appearance.

Figure 1



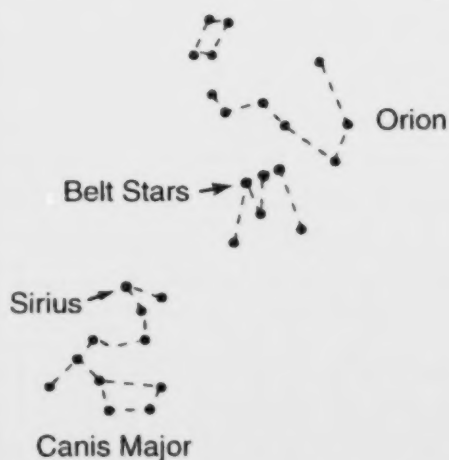
Teacher Supplement 2

For those in the southern hemisphere, south of the Equator, a similar constellation, the Southern Cross, serves as a direction finder for those seeking a night time reference point.

Throughout the year, as the Earth orbits the sun on its tilted axis, different constellations not located in the northern circumpolar zone become visible to those in the northern hemisphere.

Some of the more famous include *Orion* the hunter, a striking arrangement of some of the brightest stars in the late fall and winter sky. Nearby *Orion* are two constellations that appeared to the ancients to be Orion's dogs, *Canis Major* (which includes Sirius, the brightest star in Earth's night sky) and *Canis Minor*. During autumn, Sirius hangs in the eastern and southeastern sky like a brightly lit jewel just before sunrise. *Orion* with his three bright "belt" stars has been quite visible through the early morning hours and is about to set as the sun comes up. (See Figure 2).

Figure 2



The study of the night sky is a fascinating part of outdoor recreation. Suggestions to learn more about the stars, the constellations, and how they obtained their sometimes strange names and characters, include visits to your school or public library. Also, bookstores stock many books on star gazing, along with "star charts" which can be adjusted to the month of the year to give you a view of what constellations are in view on what dates.

Teacher Supplement 3—Locate Constellations in the Night Sky

Name _____ Overall Rating _____

Evaluation Criteria

Rating

- Constellations located _____

Basic Skills



Reading



Science

Introduction

In many forms of outdoor recreation being outside at night is required, or will be encountered. Knowing some of the more famous and easy-to-find constellations of stars in the night sky is enjoyable and can be very handy in determining directions at night.

Directions

Using information from Teacher Supplement 2—Friends in the Night Sky, and star guides and basic astronomy books, point out the following “land marks” in the night sky. (Please note some of these constellations are more easily seen at different times of the year. Check with a “Star Chart” or reference book devoted to the various locations of constellations during the various months.)

1. Orion “The Hunter”
2. The Big Dipper
3. Cassiopeia (or Cassiopeia’s Chair)
4. Pleiades
5. Pegasus “The Flying Horse”
6. Polaris “The North Star”
7. The Little Dipper
8. Triangulum
9. Sirius “The Dog Star”
10. Mars “The Red Planet”

Teacher Supplement 4—The Dakota Fire Hole

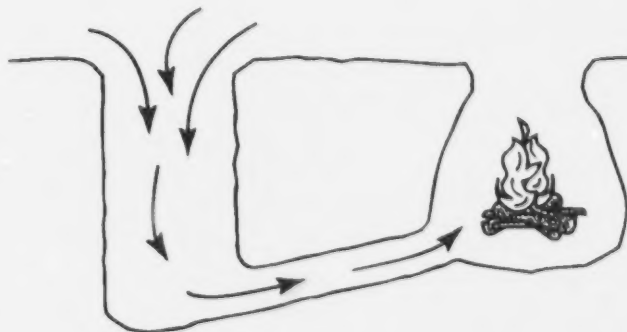
Although building bonfire-size camp fires is fun where they can be safely controlled, backpackers, day hikers, bicycle campers, and those in survival situations would be better served by a small, efficient fire that will not easily get out of control and requires little attention and only small amounts of fuel.

The Native Americans who roamed the vastness of the treeless Great Plains knew the value of such small fires and were adept at building fires in small holes where the heat from scarce firewood and animal dung could be concentrated. Somewhere, since those days of nomadic tribes of Plains Indians, the fire hole was redesigned and today it works even better. This refinement is called the Dakota Fire Hole.

To make one, you'll need a shovel and a knife. Start by digging the fire hole in the cooking area of your campsite—out of the way of foot traffic. Dig the circular hole 14 to 16 inches deep with straight sides. The diameter of your fire hole should be only slightly larger than the cooking utensils you plan to use. If the earth is mellow enough, use the knife to make the bottom of the hole "bell" shaped—to allow for a larger fuel supply.

About 12 to 18 inches away from the fire hole, dig the chimney hole. The walls of this hole are also vertical, but the hole itself should be 2 to 3 inches deeper than the fire hole.

With the two holes dug, tunnel from the bottom of the chimney hole to just above the bottom of the fire hole (a slight incline from the chimney hole to the fire hole)—taking care to make this tunnel as small in diameter as possible. By entering the side of the fire hole, the tunnel will not become clogged with coals that could stop the draft and extinguish the fire. The difference in depth in the two holes allows a better draft for a hotter fire, and allows drainage away from the first hole in case of rain.



Teacher Supplement 4

Start a fire in the bottom of the fire hole, using very small amounts of wood, gradually adding larger pieces up to those about the size of your wrist in diameter. Develop a hot bed of coals in the hole remembering you can only add fuel from the top of the hole.

Once the fire is ready, you can begin cooking by placing a grill directly on the ground over the fire hole. If the fire becomes too hot, simply put a ground cloth, your hat or coat over a portion of the chimney hole to restrict the air to the fire.

The Dakota Fire Hole also provides a good, concentrated heat source for heating water to clean cooking and eating utensils. Just set the water containers over the fire—making certain you don't cover the top of the fire hole completely, allowing proper drafting.

With your fire contained in the fire hole, winds are not likely to cause it to spread as you use it—even in grassland. Also, when it's time to leave camp, the dirt removed from the chimney and fire holes should be replaced effectively burying the fire and any remaining coals so they will not cause fires after you move on down the trail.

Teacher Supplement 5—Build a Wood-Conserving Dakota Fire Hole

Name _____ Attempt Number _____

Date _____ Overall Rating _____

Evaluation Criteria	Rating
• Holes and tunnel dug according to specifications	_____
• Fire built with small to medium sizes of wood	_____
• Fire thoroughly extinguished	_____
• Proper safety precautions observed in hole construction and fire building	_____

Basic Skills

Reading



Science

Critical
Thinking**Introduction**

When backpacking or camping in areas where little firewood is available, it is still comforting and convenient to have a fire for cooking and companionship. This assignment will provide you with an opportunity to construct a fire hole designed from those used by Native Americans who frequented the treeless Great Plains and had to conserve fuel by necessity.

Instructions

When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the evaluation criteria.

**Tools,
Equipment,
and Materials**

- Shovel
- Knife
- Firewood
- Matches or lighter
- Wire grill
- Ground cloth
- Water
- Cooking and eating utensils
- Food to prepare

Procedure

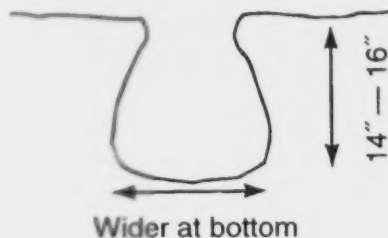
Note: Review the information concerning the fire triangle and fire safety in Unit 1 before proceeding with this activity.

- ☐ 1. Select the cooking area for your campsite, away from foot traffic.
- ☐ 2. Dig a circular hole 14 to 16 inches deep and slightly wider than your cooking utensils. (See Figure 1.)

Teacher Supplement 5

- ☐ 3. Use a knife to make the bottom of the hole "bell" shaped to provide additional space for the firewood. (See Figure 1.)

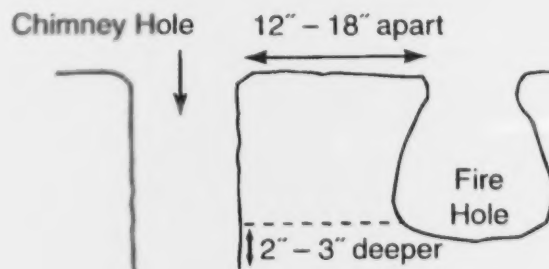
Figure 1



- ☐ 4. Dig the chimney hole approximately 12 to 18 inches away from the fire hole. This hole should be about the same width, but should be 2 to 3 inches deeper than the fire hole. (See Figure 2.)

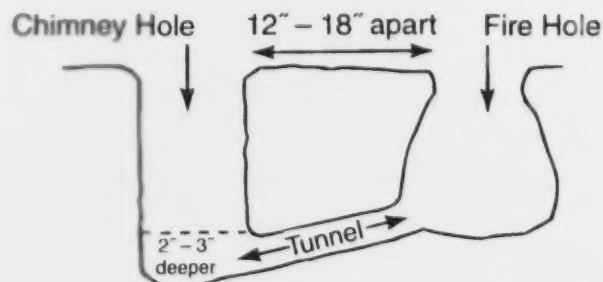
Note: This hole does not need to be "bell" shaped.

Figure 2



- ☐ 5. Dig a tunnel as small in diameter as possible leading from the bottom of the chimney hole to just above the bottom of the fire hole. (See Figure 3.)

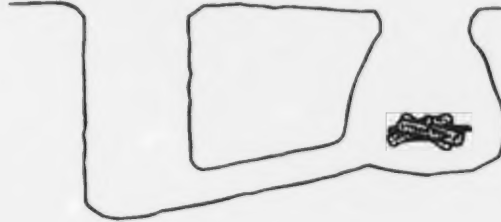
Figure 3



Teacher Supplement 5

- ☐ 6. Place small amounts of firewood at the bottom of the fire hole. (See Figure 4.)

Figure 4



- ☐ 7. Ignite the firewood, gradually adding larger pieces of wood until a hot bed of coals has been created.
- ☐ 8. Place the wire grill directly on the ground over the fire hole.
- ☐ 9. Use a ground cloth, if needed, to cover the chimney hole to restrict air to the fire.
- ☐ 10. Place cooking utensils on grill and prepare food.
- ☐ 11. Clean cooking and eating utensils using water heated on grill.
- ☐ 12. Place dirt removed from chimney and fire holes back in the holes to extinguish fire.
- ☐ 13. Pick up campsite and check for any remaining equipment and materials.

Evaluator's Comments: _____

Answers to Assignment Sheets**Assignment
Sheet 1****Interpret Graphs on Future Trends in Outdoor Recreation**

See answer key.

**Assignment
Sheet 2****Identify Outdoor Recreation Activities and Facilities Available Locally**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 3****Evaluate a Local Outdoor Recreation Site**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 4****Make a Presentation About an Outdoor Recreation Activity**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 5****Plan and Design a New Outdoor Recreation Area**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 6****Give Accurate, Easy-to-Follow Directions**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 7****Evaluate Conflict Resolution Scenarios**

Student performance should be evaluated according to criteria listed on the assignment sheet.

**Assignment
Sheet 8****Explore Career Opportunities in Natural Resources**

Student performance should be evaluated according to criteria listed on the assignment sheet.

Assignment Sheet 1—Interpret Graphs on Future Trends in Outdoor Recreation—Answer Key

Evaluation Criteria	Rating
• Answers are correct	_____
• Assignment was completed on time	_____

Introduction

Statistics abound in all areas of life. The compilation of statistics gathered through surveys and research projects is usually displayed graphically for easy interpretation. This exercise will enhance your ability to read and interpret graphs. For more detailed information on outdoor recreation activities refer to *Outdoor Recreation in the United States: Results from the National Survey on Recreation and the Environment*, a report from the USDA Forest Service available on-line at www.srs.fs.usda.gov/trends.

Answers are based on data from the web site. Students' answers may vary slightly because of their interpretation of the graphs.

Directions

Using the graphs on the following pages answer these questions.

1. What was the population of the United States in 1980? **227 million**
2. What was the population of the United States in 2000? **281 million**
3. What will be the population of the United States in 2050? **413 million**
4. What will be the population growth of the United States between 2000 and 2030? **70 million**
5. Considering that 94.5% of people participate in outdoor recreation, how many more people will participate in 2030 vs 2000? **67 million +**
6. What is the most popular outdoor recreation activity? **Walking**
7. Approximately how many participants enjoy sightseeing? **113 million**

Assignment Sheet 1—Answer Key

8. What is the most popular traditional outdoor activity on public lands?
Viewing Activities
9. What traditional outdoor activity on public lands has the least participation? Hunting
10. Approximately how many participants enjoy swimming activities?
54.2 million
11. What percent of participants visited national parks on their last visit to an outdoor recreation site? 11%
12. What outdoor recreation site did most participants last visit?
Local or state park or resort
13. Over 35% of families whose income is between \$25,000 to \$49,000 participate in camping.
14. Which family income level participates the least in camping activities?
Over \$100,000
15. Which family age group participates the most in camping activities?
16 – 24
16. Which family age group participates the least in camping activities?
60 and over
17. What three services or aids would most enhance the outdoor recreation experience of persons with disabilities?

Any order:

- a. Wheel chair availability
- b. Power scooter availability
- c. Large print brochures and signs

Written Test

Name _____

Date _____ Score _____

Objective 1

Match terms related to outdoor recreation with their definitions. Write the corresponding numbers in the blanks provided.

- | | | |
|-------------------------------|--------------------|-----------------------|
| 1. Concessions | 4. Facility | 7. Outdoor recreation |
| 2. Cultural events | 5. Leisure | 8. Scenic |
| 3. Disposable personal income | 6. Life expectancy | 9. Stress |

- _____ a. Deals with any activity that a person voluntarily does in the outdoors for enjoyment and satisfaction
- _____ b. A structure or convenience which allows something to be done more easily or enjoyably
- _____ c. View or landscape having natural beauty
- _____ d. The average age at which people die
- _____ e. Income above what is needed to buy life's necessities
- _____ f. Events or programs which train or refine the mind
- _____ g. Unoccupied time during which one may indulge in rest or recreation
- _____ h. The right to sell food, supplies, or equipment at a park or event
- _____ i. Tension, strain, or force exerted upon a body

Written Test

Objective 2

List the equipment and facilities needed for the following outdoor recreation activities.

Activity	Equipment	Facility
a. Biking		
b. Boating		
c. Fishing		
d. Hiking		
e. Swimming		

Objective 3

State the skills and licenses needed for the following outdoor recreational activities.

Activity	What special skills are needed?
a. Hunting	
b. Swimming	
c. Horseback riding	
d. Biking	
Activity	Is license or permit needed?
e. Fishing	
f. Surfing	
g. Boating	
h. Hunting	
i. Jogging	

Written Test

Objective 4

Select from the following list the major factors increasing the demand and participation in outdoor recreation. Place an "X" in the blanks next to the correct factors.

- _____ a. More leisure time increases participation.
- _____ b. More income increases participation.
- _____ c. Larger families increase participation.
- _____ d. Large workloads (more work) increase participation.
- _____ e. Greater mobility (easier travel) increases participation.

Objective 5

Select true statements concerning other factors affecting current and future participation in recreational activities. Place an "X" in the blanks next to the true statements.

- _____ a. More Americans are retiring at a later age (over 70) which increases leisure time for outdoor recreation.
- _____ b. As more women join the work force and advance toward economic equity, they will have less leisure time.
- _____ c. As accommodations for the physically challenged improve, their participation in outdoor recreation will increase.

Objective 6

List five considerations when selecting an outdoor recreation area.

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____

Written Test

Objective 7

List three reasons why people participate in outdoor recreation.

- a. _____
- b. _____
- c. _____

Objective 8

Select from the following list agencies responsible for public lands, recreation areas, and employment in outdoor recreation. Place an "X" in the blanks next to the correct agencies.

- _____ a. U.S. National Park Service
- _____ b. U.S. Forest Service
- _____ c. U.S. Department of Energy
- _____ d. State park services
- _____ e. Regional, county, and city parks
- _____ f. Private recreational businesses

Objective 9

Match employment opportunities in outdoor recreation with their appropriate description. Write the corresponding numbers in the blanks provided. Definitions continue on the next page.

- | | |
|------------------------|-------------------------|
| 1. Business management | 7. Instruction |
| 2. Entertainment | 8. Recreation manager |
| 3. Enforcement | 9. Rental |
| 4. Equipment operation | 10. Safety |
| 5. Ground care | 11. Sanitation |
| 6. Guide service | 12. Wildlife management |

- _____ a. As a park ranger, lake ranger, or game warden, conflict resolution
- _____ b. Managing a recreational area or activity
- _____ c. Paying for use of recreational equipment
- _____ d. Managing a business
- _____ e. Hunting or fishing guide, hiking guide, canoeing and rafting, horseback riding, and sightseeing
- _____ f. Control and improvement of wildlife numbers
- _____ g. The instruction of safety procedures or first aid

Written Test

Objective 10

- _____ h. As applied to outdoor recreation, this would be in the form of nature programs, outdoor plays, or musical entertainment
- _____ i. Maintaining the sanitary facilities such as garbage, restrooms, pest control, trailer dump facilities, and general cleanliness
- _____ j. Landscaping, grass trimming, camp site cleaning, trail building, and facility repair
- _____ k. Truck drivers or operators of tractors, chain saws, lawn mowers, string trimmers, water pumps, and electric motors
- _____ l. Golf, hang gliding, scuba diving, wind surfing, swimming, tennis, snow and water skiing

Select from a list business opportunities in outdoor recreation. Place an "X" in the blanks next to the business opportunities.

- _____ a. Truck driver
- _____ b. Recreation driver
- _____ c. Bait shop
- _____ d. Fish farms
- _____ e. Park ranger
- _____ f. Excursion boat
- _____ g. Sporting good store
- _____ h. Hunting preserve
- _____ i. Safety instructor

*Permission to duplicate this test is granted.

Written Test—Answer Key

Objective 1

Match terms related to outdoor recreation with their definitions. Write the corresponding numbers in the blanks provided.

- | | | |
|-------------------------------|--------------------|-----------------------|
| 1. Concessions | 4. Facility | 7. Outdoor recreation |
| 2. Cultural events | 5. Leisure | 8. Scenic |
| 3. Disposable personal income | 6. Life expectancy | 9. Stress |

- 7 a. Deals with any activity that a person voluntarily does in the outdoors for enjoyment and satisfaction
- 4 b. A structure or convenience which allows something to be done more easily or enjoyably
- 8 c. View or landscape having natural beauty
- 6 d. The average age at which people die
- 3 e. Income above what is needed to buy life's necessities
- 2 f. Events or programs which train or refine the mind
- 5 g. Unoccupied time during which one may indulge in rest or recreation
- 1 h. The right to sell food, supplies, or equipment at a park or event
- 9 i. Tension, strain, or force exerted upon a body

Written Test—Answer Key

Objective 2 List the equipment and facilities needed for the following outdoor recreation activities.

Activity	Equipment	Facility
a. Biking	Bicycle, helmet	Bike trails, safety signs
b. Boating	Motor or sailboat	Lake or large river
c. Fishing	Fishing pole, reel, bait	Lake, stream, or farm pond
d. Hiking	Shoes, pack, food, maps	Hiking trails, scenic area
e. Swimming	Life vest, "buddy"	Indoor or outdoor swimming area

Objective 3 State the skills and licenses needed for the following outdoor recreational activities.

Activity	What special skills are needed?
a. Hunting	Knowledge of outdoors, safety
b. Swimming	Swimming technique, safety
c. Horseback riding	Saddling, caring for a horse, safety
d. Biking	Biking techniques, safety
Activity	Is license or permit needed?
e. Fishing	Yes
f. Surfing	No
g. Boating	Yes
h. Hunting	Yes
i. Jogging	No

Written Test—Answer Key

Objective 4

Select from the following list the major factors increasing the demand and participation in outdoor recreation. Place an "X" in the blanks next to the correct factors.

- ☒ a. More leisure time increases participation.
- ☒ b. More income increases participation.
- ☐ c. Larger families increase participation.
- ☐ d. Large workloads (more work) increase participation.
- ☒ e. Greater mobility (easier travel) increases participation.

Objective 5

Select true statements concerning other factors affecting current and future participation in recreational activities. Place an "X" in the blanks next to the true statement.

- ☐ a. More Americans are retiring at a later age (over 70) which increases leisure time for outdoor recreation.
- ☐ b. As more women join the work force and advance toward economic equity, they will have less leisure time.
- ☒ c. As accommodations for the physically challenged improve, their participation in outdoor recreation will increase.

Objective 6

List five considerations when selecting an outdoor recreation area.

Any five of the following:

- Natural beauty
- Amount of crowding
- Sanitation facilities
- Parking availability
- Available information
- Picnic areas
- Cultural events
- User fees
- Concessions
- Organized sports or competitive events
- Guided activities

Written Test—Answer Key

Objective 7

List three reasons why people participate in outdoor recreation.

Any three of the following:

- Fitness
- Social
- Excitement
- Experience self and nature
- Conformist

Objective 8

Select from the following list agencies responsible for public lands, recreation areas, and employment in outdoor recreation. Place an "X" in the blanks next to the correct agencies.

- X a. U.S. National Park Service
- X b. U.S. Forest Service
- c. U.S. Department of Energy
- X d. State park services
- X e. Regional, county, and city parks
- X f. Private recreational businesses

Objective 9

Match employment opportunities in outdoor recreation with their appropriate description. Write the corresponding numbers in the blanks provided. Definitions continue on the next page.

- | | |
|------------------------|-------------------------|
| 1. Business management | 7. Instruction |
| 2. Entertainment | 8. Recreation manager |
| 3. Enforcement | 9. Rental |
| 4. Equipment operation | 10. Safety |
| 5. Ground care | 11. Sanitation |
| 6. Guide service | 12. Wildlife management |
-
- 3 a. As a park ranger, lake ranger, or game warden, conflict resolution
 - 8 b. Managing a recreational area or activity
 - 9 c. Paying for use of recreational equipment
 - 1 d. Managing a business
 - 6 e. Hunting or fishing guide, hiking guide, canoeing and rafting, horseback riding, and sightseeing
 - 12 f. Control and improvement of wildlife numbers
 - 10 g. The instruction of safety procedures or first aid

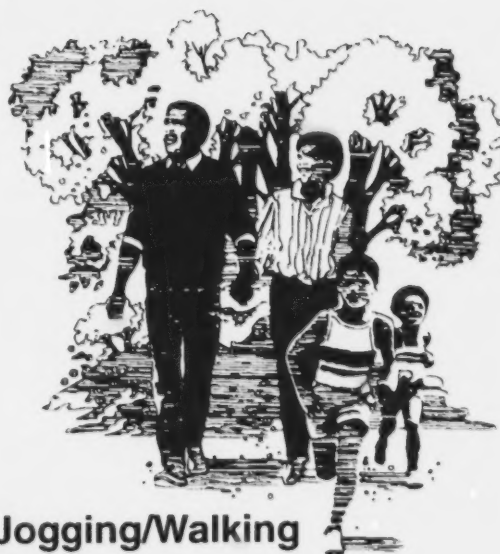
Written Test—Answer Key

	<u>2</u> h. As applied to outdoor recreation, this would be in the form of nature programs, outdoor plays, or musical entertainment <u>11</u> i. Maintaining the sanitary facilities such as garbage, restrooms, pest control, trailer dump facilities, and general cleanliness <u>5</u> j. Landscaping, grass trimming, camp site cleaning, trail building, and facility repair <u>4</u> k. Truck drivers or operators of tractors, chain saws, lawn mowers, string trimmers, water pumps, and electric motors <u>7</u> l. Golf, hang gliding, scuba diving, wind surfing, swimming, tennis, snow and water skiing
Objective 10	Select from a list business opportunities in outdoor recreation. Place an "X" in the blanks next to the business opportunities. <u> </u> a. Truck driver <u> </u> b. Recreation driver <u> X </u> c. Bait shop <u> X </u> d. Fish farms <u> </u> e. Park ranger <u> X </u> f. Excursion boat <u> X </u> g. Sporting good store <u> X </u> h. Hunting preserve <u> </u> i. Safety instructor *Permission to duplicate this test is granted.

Why Do People Enjoy These Activities?



Golfing



Jogging/Walking

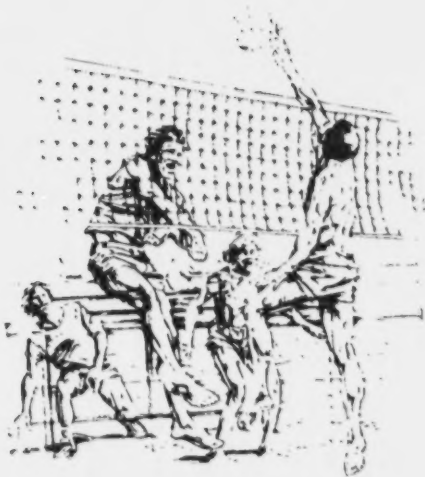


Tennis



Biking

Why Do People Enjoy These Activities? (Continued)



Volleyball



Skiing



Horseback Riding

Why Do People Enjoy These Activities? (Continued)



Picnicking



Fishing



Hunting

Career Opportunities in Outdoor Recreation

	Business Management	Entertainment	Enforcement	Equipment Operation	Ground Care	Guidance Service or Inst.	Recreation Management	Rental	Safety	Sanitation
Archery	X			X	X	X	X	X	X	
Biking	X			X	X			X	X	
Boating	X	X	X	X		X	X	X	X	X
Camping	X	X	X	X	X	X	X	X	X	X
Canoeing	X	X	X	X		X	X	X	X	
City Parks	X	X	X		X		X		X	X
Fishing	X		X	X		X		X	X	
Four-Wheeling	X		X	X	X			X	X	
Golfing	X				X	X	X	X	X	
Hang Gliding	X		X	X		X	X		X	
Hiking					X	X		X	X	
Horseback Riding	X				X	X	X	X	X	
Hunting	X		X	X		X			X	
Jogging/Walking						X			X	
Lawn Games					X			X	X	
Picnicking		X			X				X	X
Rock/Mountain Climbing	X		X	X	X	X	X	X	X	
Scuba Diving	X		X	X		X	X	X	X	
Sight-Seeing	X	X			X	X	X		X	
Snow Skiing	X		X	X	X	X	X	X	X	
Surfing	X			X		X		X	X	
Swimming	X				X	X	X		X	X
Tennis	X			X	X	X			X	
Tourism	X				X	X	X	X	X	X
Water Skiing	X		X	X	X	X	X	X	X	



Introduction to Natural Resources

Third Edition

Student Guide



Introduction to Natural Resources

Third Edition

Student Guide

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- Unit 7: Forestry
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- Unit 9: Wildlife Habitats
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Unit 1**Outdoor Safety and First Aid****Unit Contents**

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Objective Sheet

Unit
Objective

After completing this unit, the student should be able to apply basic safety and first aid skills that may be needed for outdoor-related situations. The student should demonstrate these competencies by completing the assignment sheets and job sheets and by scoring a minimum of 85 percent on the written test.

Specific
Objectives

After completing this unit, the student should be able to:

1. Match terms related to outdoor safety and first aid with their definitions.
2. Select true statements concerning basic first aid procedures for emergency situations.
3. List ten items that should be found in a basic first aid kit.
4. Describe the two types of poisonous snakes found in the United States.
5. Distinguish among types of poisonous plants found in the United States.
6. Distinguish between the two types of poisonous spiders found in the United States.
7. List two safety precautions to take for each type of inclement weather.
8. Explain how the components of the fire triangle work.
9. Match classes of fires with their definitions.
10. Match types of fire extinguishers with the classes of fires for which they were designed.
11. Complete statements concerning purposes of a material safety data sheet.
12. Complete statements concerning guidelines for lifting and carrying items safely.
13. Read wind chill index and water survival charts. (Assignment Sheet 1)
14. Interpret portable fire-extinguisher symbols. (Assignment Sheet 2)
15. Analyze scenarios to determine appropriate safety and first aid procedures. (Assignment Sheet 3)
16. Interpret material safety data sheets. (Assignment Sheet 4)
17. Analyze current reports concerning outdoor safety and first aid. (Assignment Sheet 5)

Objective Sheet

18. Demonstrate the Heimlich maneuver for an adult choking victim. (Job Sheet 1)
19. Lift a heavy object properly. (Job Sheet 2)

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Information Sheet

Key terms:

- **Accident**—Any suddenly occurring, unintentional event that causes injury or property damage
- **Carelessness**—Failure to think before one acts; failure to pay attention
- **Hazard**—Potential source of danger
- **Safety**—State or condition of being safe; freedom from danger, risk, or injury

Introduction

Hazards are often present in working in natural resources or enjoying outdoor recreation. Hazards can potentially cause injury or, in severe situations, death. Fortunately, the risk we take can be reduced.

Practicing **safety** reduces the likelihood of an accident. Safety steps to be free of harm and danger vary with the nature of the hazards that are involved. For example, live animals pose hazards that are quite different from those in operating power equipment. You need to make safety a habit. When you do, safe practices become routine. This helps prevent injury and loss due to accidents or **carelessness**.

Many natural resource occupations and outdoor recreation activities take place in varied weather conditions. **Accidents** do happen. A person who participates in these activities should be familiar with survival and first aid techniques. This includes both preparation and the use of logical techniques if problems occur.

If you are participating in a natural resource occupation or an outdoor recreation activity you must be aware of basic first aid procedures. If possible, attending a Red Cross first aid class would be time well invested. Having the correct first aid equipment, and knowing the proper procedures for using it, will keep the chances of a fatality to a minimum.

Objective 1

Terms

Note: Please refer to "Key terms" for definitions.

Accident	Heat exhaustion
Antiseptic	Heat stroke
Cardiopulmonary resuscitation (CPR)	Heimlich maneuver
Carelessness	Hypothermia
First aid	Material safety data sheet (MSDS)
First-degree burn	Safety
Frostbite	Second-degree burn
Habitat	Shock
Hazard	Third-degree burn
Hazardous material	Topical

Information Sheet

Objective 2

Basic first aid procedures for emergency situations

Key term:

- **First aid**—Immediate temporary care given the victim of an accident or sudden illness or trauma until the services of a physician can be obtained

Caution: Given the increased awareness of diseases carried by bloodborne pathogens, hepatitis B, Human Immunodeficiency Virus (HIV), and others, the U.S. Department of Labor in its brochure, *Occupational Exposure to Bloodborne Pathogens*, states that universal precautions be observed any time blood or other human body fluid is present. This precaution requires employers and employees to assume that all human blood and specified human body fluids are infectious for HIV, HBV, and other bloodborne pathogens. When it is impossible to determine the type of body fluid present, all body fluids are to be considered as potentially infectious.

a. Bleeding

- Minor bleeding—Apply antiseptic solution or cream and dress wound with sterile bandages.
- Severe bleeding—Elevate the wound and apply dressing or manual pressure to the wound.

b. Burns

Key terms:

- **First-degree burn**—Burn affecting only the outer skin layers; characterized by redness and pain
- **Second-degree burn**—Burn penetrating beneath the superficial skin layers; characterized by swelling and blisters
- **Third-degree burn**—Burn that destroys all skin layers and underlying tissue; characterized by charring or white, leathery appearance of the skin and lack of pain
- **Chemical**—Flush skin thoroughly with clean water and seek medical attention.
- **Electrical**—Locate both entrance and exit burns; cool with a damp compress, then cover with a dry, sterile dressing; and cover victim with a blanket and elevate feet and legs to prevent shock and loss of body heat.
- **First-degree burn**—Hold under cold water, then apply dry, sterile dressing.
- **Second-degree burn**—Cool with a damp compress, taking care not to break the blisters, then cover with a dry, sterile dressing to prevent infection.

Example: A severe sunburn

Information Sheet

- **Third-degree burn**—Cool with a damp compress and then cover with a dry, sterile dressing; cover the victim with a blanket, elevate feet and legs to prevent shock and loss of body heat.

Note: Third-degree burns are not painful because nerve tissue has been destroyed. Third-degree burns are the most severe and many times are life threatening, requiring lengthy treatment and skin grafts.

c. **Traumatic shock**

Key term:

- **Shock**—A medical condition in which the operation of the circulatory system is partially or completely impaired by the body's reaction to injury or psychic disturbance.

Note: Traumatic shock may occur within any time period following an injury. Although the injury itself may not be life threatening, the onset of shock resulting from the injury can be fatal.

- Recognize signs and symptoms of traumatic **shock**.

Early stages
Pale or bluish skin that is cool to touch
Moist, clammy skin or perspiration has occurred
General weakness
Rapid, weak pulse
Rapid, shallow, possibly irregular breathing
Restlessness or anxiety
Vomiting or nausea
Excessive thirst
Late stages
An attitude of not caring
Unresponsiveness
Sunken eyes with dilated pupils
Spotty or mottled appearance of skin; bluish color to lips and nailbeds
Low body temperature; cool, clammy skin
Loss of consciousness leading to death if untreated

- Lay victim down.
- Elevate victim's legs slightly.
- Cover to prevent loss of body heat.

Note: In some cases it may be necessary to have someone lie in close contact with victim to conserve body heat.

Information Sheet

d. Falls

- Head injury—Lay victim flat, then control bleeding and shock.
- Less severe falls—Check for injury and provide first aid as appropriate and do not move victim or allow victim to move if a neck or back injury is suspected.

Caution: If either neck or back is broken, moving the victim could sever or damage the spinal cord causing immediate death or paralysis.

e. Choking

Key term:

- **Heimlich maneuver**—Procedure for forcing a foreign object from the windpipe of a choking victim
- Recognize signs and symptoms of choking:
 - Victim clutches throat (universal sign of choking)
 - Victim has trouble speaking or breathing
 - Skin turns pale or bluish
 - Victim loses consciousness
- Perform the **Heimlich maneuver**.

f. Electrical accident

Caution: If the victim is still in contact with a live electrical circuit, do not endanger yourself by touching the victim, or metal objects, water, or wet ground. You may well become a victim yourself as the current passes through your body. Death can be instantaneous.

Key term:

- **Cardiopulmonary resuscitation (CPR)**—Procedure for restoring normal breathing after cardiac arrest

Note: Although exposure to electrical current (commonly known as a "shock") can cause symptoms of shock, the term shock is a medical term applied to the impairment of the circulatory system and is common to victims of traumatic injuries of many kinds.

- Do **NOT** provide assistance until all electrical current has been shut off.

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- Administer **CPR** if necessary.
- Treat for traumatic shock.
- Treat for electrical shock.

Note: Always look for both an entrance and an exit wound with an electrical burn. Both may resemble a bull's-eye consisting of a central charred zone, a middle zone of gray tissue, and an outer red zone.

g. **Heat exhaustion**

Key term:

- **Heat exhaustion**—Fatigue, weakness, and sometimes collapse due to loss of body fluids through sweating and lack of adequate water intake
- Recognize the signs and symptoms of **heat exhaustion**:
 - Profuse perspiration
 - Pale, clammy skin
 - Rapid, weak pulse
 - Rapid, shallow breathing
- Immediately move victim to a cool place.
- Lay victim flat.
- Elevate victim's feet slightly.
- Remove as much of the victim's clothing as possible.
- Sponge victim with cool water.

h. **Heat stroke**

Key term:

- **Heat stroke**—Immediate, life-threatening emergency in which the victim has extremely high body temperature and a failure of the sweating mechanism

Note: Heat stroke is a true emergency. Act quickly or the victim will suffer brain damage or death.

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Information Sheet

- Recognize the signs and symptoms of **heat stroke**:

- Little or no perspiration
- Hot, flushed skin
- Rapid, weak pulse
- Rapid, shallow breathing

- Move victim immediately to a cool location.

- Cool victim as quickly as possible.

Note: Do not take time to remove a victim's clothing until after initial cooling, such as spraying the victim with a garden hose, the contents of an ice chest or drinking water container, or immersing in a nearby stream or pond.

- Rub ice on victim's extremities.

i. **Mild hypothermia**

Key term:

- **Hypothermia**—Below normal body temperature usually due to overexposure to low temperatures

Note: "Hypo" means low or under. "Hyper" means high or over.

- Recognize the signs and symptoms of *mild hypothermia*:

- Shivering
- Complaints of cold
- Loss of coordination
- Psychological withdrawal and apathy

- Get the victim out of cold, wet conditions.
- Replace wet clothing with dry clothing, or add insulation.
- Place victim in warm environment.
- Offer warm liquids or food only if victim is fully conscious.

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j. **Moderate hypothermia**

Key term:

- **Frostbite**—Tissue damage due to freezing of tissue fluids
- Recognize the signs and symptoms of *moderate* hypothermia:
 - Listlessness, mental confusion, refusal to recognize problem
 - Uncontrolled shivering
 - Slurred speech
 - Stumbling
- Cover victim at the site rather than walking to shelter.
- Treat victim gently and avoid unnecessary jostling or movement.
- Do not allow victim to exercise or move.
- Check victim for other injury, including **frostbite**.

k. **Severe hypothermia**

- Recognize the signs and symptoms of severe hypothermia:
 - Unresponsiveness
 - Decreased pulse and respiration
 - Cessation of shivering
 - Physical collapse
- Treatment should be attempted only if victim cannot be evacuated for professional medical care.
- Deliver warmth to head, neck, armpit, and groin areas by application of warm water bottles, warmed blankets, or another warm body.

l. **Animal bite**

Key term:

- **Antiseptic**—A substance that prevents infection by killing bacteria

Note: First aid for animal bites is similar to any other wound, except for the need to be aware of the possibility of rabies infection.

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Information Sheet

- Cleanse wound thoroughly with soap and water; apply **antiseptic**.
- Cover bite wound with a sterile dressing and bandage.
- Seek medical attention, especially if the bite is on the face, head, or neck areas.

m. **Insect stings**

Note: In case of a bee sting, the insect's stinger likely will still be imbedded in victim's skin. Scrape stinger sideways to remove. Never pinch the stinger to remove as this actually will inject more toxin into the wound.

- **Ordinary reaction**—Wash wound with soap and water and apply ice to reduce swelling
- **Allergic reaction**

Note: A victim with an allergic reaction to a bee sting is suffering from anaphylactic (respiratory arrest) shock and needs prompt treatment with epinephrine by injection or inhalation.

- If possible, immediately evacuate the victim to a hospital or physician's office.

Note: Have someone call ahead to notify the party of the situation and your planned arrival.

- If transportation is not immediately available, lay the victim down or help the victim to a position in which he or she can breathe more easily.
- Elevate the victim's legs if possible.
- While waiting for emergency aid, remove the stinger and perform first aid actions for an ordinary sting.

n. **Snake bite**

- **Nonpoisonous**
 - Cleanse wound with plain water and soap.
 - Cover with sterile dressing.
 - Seek medical attention.

- Poisonous—Pit viper

Note: Within the medical community there is a vigorous controversy over the advisability of using antivenin injections in the treatment of snake bites originating from copperheads, rattlesnakes, and cottonmouth (water moccasin). Although in the case of the coral snake, antivenin treatment is recommended. Because of the conflicting opinions on the use of similar materials for pit viper bites, professional medical assistance is advisable and decisions on the use of antivenin should be left up to those professional individuals.

- Immobilize the victim.
- Have him or her lie down, and keep quiet.
- Do not give victim liquor.
- Apply a constricting band about the affected appendage just above the fang marks as soon as possible.

Note: Under no circumstances should the constricting band be tight enough to block venous or arterial blood flow. Also, as edema (tissue swelling due to concentrations of water and waste material) builds, the band should be moved further from the wound periodically.

- Apply suction as quickly as possible to wounds to remove venom.

Note: Suction cups, "Extractor" devices, and mouth suction (be aware of cautions on bloodborne pathogens) are recommended to remove as much venom as possible. Suction should be continued up to four hours after the bite, although the amount of venom removed by this method will be sharply reduced after the first 15 minutes. Still, as pit viper venom degenerates tissue and blood cells near the wound, suction removal of this waste material will be helpful in preventing the victim's body from having to filter this material through the lymphatic and renal systems.

- Apply hot and cold compresses, alternated every three to five minutes.

Note: Raising the temperature of venom tends to break it down, and lowering temperatures tend to cause the capillary system to contract. The continual differing stimuli help provide fresh oxygenated blood flow to the wound area and tend to prevent additional tissue damage.

- Seek medical attention at once.

Information Sheet

- **Poisonous—Coral snake**

Note: The venom of the coral snake is similar to that of the cobra in that it attacks the nervous system, unlike venom of pit vipers which attacks the blood and circulatory system. Because of this, immediate medical attention and administration of antivenin is necessary. Death can come rapidly.

- Immobilize the victim. Have him or her lie down and keep quiet.
- Apply arterial tourniquet (tight enough to stop blood flow) up to 30 minutes.

- o. **Tick bites**

Key term:

- **Topical—On the skin**

- Carefully remove an imbedded tick with tweezers by grabbing the tick as close to the skin as possible and pulling gently straight out.

Note: Removing the tick with the thumb and forefinger carries the risk of crushing the tick and actually injecting the victim with the juices of the tick.

- Wash area with soap and water.
- Use a **topical** antiseptic and be alert for signs of tick-borne diseases for several weeks.

Note: Some ticks are carriers of Lyme disease and Rocky Mountain Spotted Fever.

- p. **Spider bites**

- Apply cold water or ice; a topical antiseptic may be used; take aspirin or acetaminophen for pain; and rest.

Note: The bite of either the black widow or brown recluse spider is highly toxic and dangerous. If bitten by either of these species (or if you are not certain of the biting spider's identification) seek medical attention at once.

Objective 3

Contents of a basic first aid kit

- a. Antiseptic to kill bacteria
- b. Adhesive bandages
- c. Gauze pads, various sizes
- d. Gauze roller bandages
- e. Triangular bandages for large wounds and slings
- f. Scissors
- g. Tweezers
- h. Elastic bandages for sprains
- i. Pain relievers
- j. Snake bite kit

Objective 4

Types of poisonous snakes

Key term:

- **Habitat**—The region where a plant or animal naturally grows or lives

Note: The poisonous snakes of the U.S. include members of two families, *Elapidae*, represented by the coral snakes; and *Viperidae* (subfamily *Crotalidae*), represented by the copperhead, cottonmouth (water moccasin), and rattlesnakes.

a. Coral snake

- Small snake with colorfully-banded markings of red, yellow, and black rings with red and yellow rings touching

Note: Any snake in the eastern half of the U.S. with red and yellow rings touching is venomous. An old saying goes, "Red and yellow can kill a fellow. Red and black, a friend of Jack."

R	Y	R	Y	B	Y	R
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Venomous

R	B	Y	B	R	B	Y
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Nonvenomous

Information Sheet

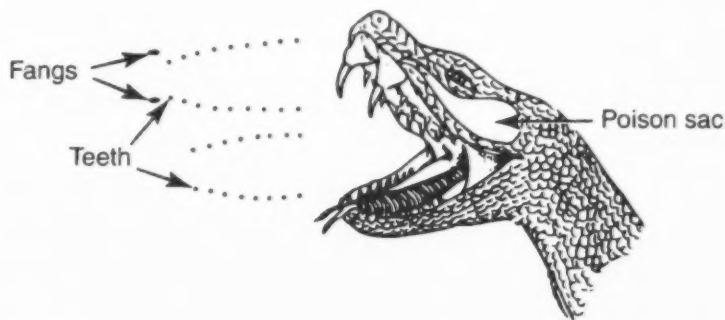
- Tubular fangs that inject a highly toxic venom which attacks the victim's nervous system
- A double row of plates beneath the tail
- Round pupils
- Black nose
- **Habitat** is eastern one-third of Texas, southern Arkansas, Louisiana, Mississippi, Alabama, Georgia, Florida, and northward across the coastal plain to southern North Carolina.

b. Pit vipers

- Usually two well-developed fangs capable of injecting venom which affects the circulatory system and blood

Note: While the bite of a copperhead is usually not fatal, the cottonmouth (water moccasin) and even small rattlesnakes are extremely dangerous.

Figure 1



- A pit between the eye and nostril on each side of face
 - Vertically elliptical pupils
 - Triangular-shaped head with a narrow neck
 - One row of plates beneath the tail
 - Habitat and color markings
- Copperhead—Alternate light and dark brown saddle bands the full length of the body; found in the southeastern one-third of the U.S. from the Big Bend of Texas across the eastern two-thirds of Oklahoma, the eastern third of Kansas to extreme southeastern Nebraska and eastward to New York state.

- Cottonmouth—Dark brownish-black with indistinct bands (although many snakes are similarly marked); large scales over the eye preventing upward vision and facial pit are easily distinguished; found in the southeastern one-fourth of the U.S. in generally slow-moving and stagnant waters
- Rattlesnake—Rattles, facial pits; markings differ among the more than 30 species and subspecies of rattlesnakes; found in isolated areas throughout the lower 48 states of the U.S.

Objective 5

Types of poisonous plants

Note: The effects of poisonous plants can be headache, fever, itching, redness, and/or rash. Both poison ivy and poison oak are poisonous all year.

- a. Common poison ivy (*Rhus radicans*)

Figure 2



- Grows as a small plant, a vine, and as a large shrub
- Has greenish white flowers, and whitish berries that grow in clusters
- Leaves always consist of three glossy leaflets
- Grows throughout the U.S. except in California and parts of adjacent states

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Information Sheet

b. Western poison oak (*Rhus diversiloba*)

Figure 3



- Grows in shrub and sometimes in vine form
- Leaves always consist of three leaflets
- Has greenish white flowers, and whitish berries that grow in clusters
- Grows in California and parts of adjacent states
- Sometimes called poison ivy, or yeraa

c. Poison sumac (*Rhus vernix*)

Figure 4



- Grows as a woody shrub or small tree from 5 to 25 feet tall
- Grows in most of the eastern third of the U.S.
- Also known as swamp sumac, poison elder, poison ash, poison dogwood, and thunderwood

Objective 6

Types of poisonous spiders

- a. Black widow (*Latrodectus mactans*)

Figure 5



- Shiny black body with red or orange "hour glass" design on its abdomen
- Found in trash dumps, ash piles, under boxes, crates, stones and wood piles, and in outdoor toilet facilities
- Bite looks like a pin prick; severe pain caused by nerve toxins begins within minutes accompanied by sweating, cramps, nausea, and difficult speaking and breathing

- b. Brown recluse (*Loxosceles reclusa*)

Figure 6



- Dark tan to dark brown body with lighter brown head; dark "fiddle or violin" design on back of thorax
- Found in buildings, closets, old clothes, on undersides of tables and chairs, an under rocks and bark
- Bite area swells painfully and grows hard; blisters or ulcers form and a rash may cover the body within 24-48 hours; accompanied by chills, vomiting, nausea, and fever; within one to two weeks the skin and muscle at the bite area slough off, leaving severe scars

Information Sheet

Objective 7

Safety precautions to take in inclement weather

a. Lightning

- Take shelter in a vehicle with windows rolled up or in a building if possible.
- Avoid sheltering under trees.
- Avoid hilltops and open country during approach and duration of thunderstorms.

Note: Take lightning seriously. More people are killed by lightning each year than by tornadoes and hurricanes. Lightning strikes can occur far in advance and to the rear of an active thunderstorm.

b. Heavy rain

- Avoid low-lying areas, or obvious drainage areas when heavy thunderstorms are present (unless the direct approach of a tornado is imminent).
- Never drive into running water.

Note: An average car or pickup truck can be floated and washed downstream in as little as 20 to 24 inches of water.

- Take lightning precautions.

c. Tornado

- Seek shelter in low areas.
- If no shelter is available, move at right angles to the approach of the funnel cloud.
- Do not seek shelter in an automobile or mobile home.

d. Winter storm

- Be alert to weather forecasts.
- Be prepared with food, water, and sheltering material such as blankets, tents, and candles.
- Be alert to signs of hypothermia if stranded in a winter storm.
- Take precautions to avoid carbon monoxide poisoning if stranded in a vehicle as snow may build up around exhaust system.

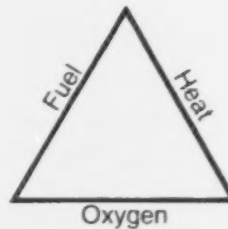
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Objective 8

Components of the fire triangle

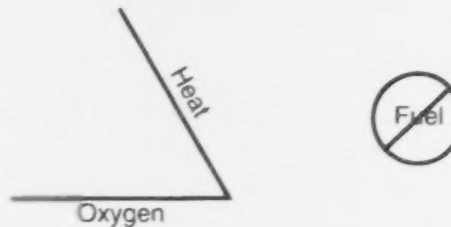
Note: The fire triangle represents the three elements that are necessary for fire. Combustion can occur only when the fire triangle is complete. A fire will stop burning if any part of the fire triangle is broken.

Figure 7



- a. **Fuel** is anything that burns at the fire site. Examples are dried grass or leaves, small trees, large trees and limbs, brush stumps, gasoline, oil, and paper. The arrangement of the fuel will affect the amount of heat. The temperature must be high enough to ignite the fuel. The source of fuel must be eliminated to stop a fire.

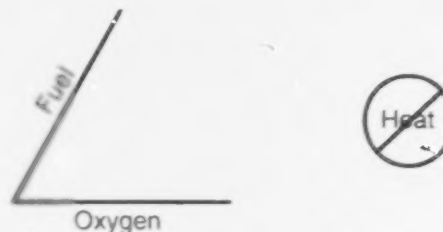
Figure 8



In the case of a grass or timber fire, clear the area, cut or plow a firebreak, and use another fire to rob the fire of fuel between it and the fire break.

- b. **Heat** comes from the fire itself and, as long as there is plenty of fuel and oxygen, a fire will continue to burn, producing greater heat. The temperature must be high enough to ignite the fuel. Heavy fuels such as logs and timber burn hotter. When the heat is removed, the fire triangle is broken.

Figure 9



Information Sheet

- c. **Oxygen** must be available in the air and the more oxygen a fire has, the faster and hotter it will burn. Wind brings more oxygen to a fire. Remove the oxygen supply to break the fire triangle.

Figure 10



- For grass and timber fires, smother with dirt or sand, swat with wet burlap sacks, swatter tools, and/or shovel.
- In the case of gasoline or electrical fires, use the proper fire extinguisher.

Objective 9

Classes of fires and their definitions

- Class A**—Fires that occur in ordinary combustible materials such as wood, rags, paper, and rubbish
- Class B**—Fires that occur with flammable liquids such as gasoline, oil, grease, paint, solvent, and thinners
- Class C**—Fires that occur in or near electrical equipment such as motors, switchboards, and electrical wiring
- Class D**—Fires that occur with combustible metals such as magnesium, phosphorus, or sodium

Caution: Never apply water to a flammable liquid or gas fire. Such action can cause the fire to spatter and spread.

Objective 10

Types of fire extinguishers and classes of fires they were designed to extinguish

- Pressurized water—Used on Class A fires
- Foam—Used on Class A and B fires
- Carbon dioxide (CO_2)—Used on Class B and C fires
- Dry chemical—Used on Class B, C, and D fires

Objective 11

Purposes of a material safety data sheet (MSDS)

Key terms:

- **Material safety data sheet (MSDS)**—Form that lists and explains each of the hazardous materials that an employee works with so the employee can safely use the material and respond to emergency situations
- **Hazardous material**—Any cancer-causing, corrosive, toxic, irritant, oxidizer, or other material that has the potential to damage specific body organs

Note: The federal Occupational Safety and Hazard Act (OSHA), administered by the U.S. Department of Labor, requires employers to keep material safety data sheets (MSDS) on all hazardous substances used by employees. Federal law requires MSDSs be available to employees and that employees be taught to read and understand them. Working outdoors, employees may encounter fertilizers, pesticides, fuels and lubricants, and various other chemicals which may be covered under OSHA's MSDS regulations. Employees should be aware of their responsibilities and those of their employers concerning access to MSDS information and training.

- a. To inform the user of the **hazardous material's** physical properties or fast-acting health effects that make it dangerous to handle
- b. To tell the user the level of protective gear needed
- c. To tell the user the first aid treatment necessary if exposed to the hazardous material
- d. To tell the management and the user the preplanning needed for safely handling spills, fires, and day-to-day operations with the material
- e. To tell the user how to respond to accidents

Objective 12

Guidelines for lifting and carrying items safely

- a. Before lifting
 - Inspect the item to be lifted for jagged edges, splinters, grease, or other slippery surfaces.
 - Wear gloves for protection.
 - Wear lower back support

Example: Leather lower-back support belt
 - Plan your route before you lift.
 - Clear any obstacles from your path.
 - Assess the weight of the load.
 - Get help for heavy loads.

Information Sheet

b. Lifting

- Place your feet as close to the load as possible, one foot alongside the load and the other behind it.
- Bend your knees, keeping your back and neck straight and your chin tucked in.
- Grasp the load firmly with your fingers and hands.
- Draw your arms in close to your body.
- Stand slowly and lift smoothly, *using your legs*.

c. Carrying

- Hold item close to your body.
- Do not allow load to block your vision.
- Do not change your grip or twist your body to change direction.

Note: Twisting the back while carrying a load (even a small one) can result in severe back injury.

d. Setting the load down

- Bend your knees.
- Keep your back and neck straight and aligned.
- Place load carefully where you want it, taking care not to allow it to rest on your feet or fingers.

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Student Supplement 1—A Systematic Look at First Aid

First aid can be defined as "immediate temporary care given the victim of an accident or sudden illness or trauma until the services of a physician can be obtained."

The goal of first aid is to intervene actively to prevent further damage, to provide life support, and to begin effective treatment of the victim's condition, to minimize injury and prevent death. Although first aid is not a substitute for medical care, those trained in first aid are able to assess the nature and extent of an emergency and determine the best course of action to take until professional medical help arrives.

Scene Survey

First aid begins with a scene survey. Before approaching a victim, a survey of the area is necessary to determine if conditions surrounding the incident may place the victim and the rescuer in danger.

Primary Survey

Next, the primary survey will determine if lifesaving procedures must be immediately performed to save the victim's life. The primary survey involves checking the ABCs:

- a. Is the AIRWAY open and the victim's neck stabilized?

The severity of spinal cord injuries has decreased 30-45 percent since awareness that the neck of an accident victim must be stabilized (supported or immobilized) before moving the victim.

- b. Is the patient BREATHING?
- c. Is the victim's blood CIRCULATING? Is there a pulse? Or is there active bleeding?

Lifesaving procedures, including cardiopulmonary resuscitation (CPR), may be needed to provide basic life support when a victim has no pulse and is not breathing. The Heimlich maneuver aids choking victims by forcing ejection of obstructing material from the windpipe.

Secondary Survey

The secondary survey is a total body examination, a pulse check, respiration count (breaths per minute), and observation of skin conditions. For electrical shock victims, this would be the time to search for both entrance and exit wounds.

Student Supplement 1

For severe medical problems, such as heart attack, stroke, or internal bleeding, the only outward sign of problems may be shock. Those in shock will have pale, cool, and clammy skin; a rapid and weak pulse (over 100 beats per minute); more than 20 breaths per minute; weakness; and confused behavior. Treatment involves minimizing body heat loss, elevating the legs without disturbing the rest of the body, and getting help as quickly as possible.

**A Choking
Adult****Student Supplement 2—Using the Heimlich Maneuver**

Someone who is choking and cannot breathe has just four minutes before death or permanent brain damage takes place. Thousands of adults and children die from choking each year. Fortunately, in 1973, Dr. Henry Heimlich created a life-saving technique to help choking victims. The Heimlich maneuver is so simple to learn that an 8-year-old child was reported to have save the life of his older brother by using this technique.

Recognize choking

Most often, adults begin choking while they are eating. Instinctively, people who are choking clutch their throats. A person who is choking cannot talk to you, but if you ask someone who is clutching his or her throat "Are you choking?" in most cases the person can nod his or her head "yes." There are three other symptoms of choking. First, the person has trouble speaking or breathing. Second, the skin turns pale or bluish. Finally the victim loses consciousness. Never allow a choking victim to leave the room alone.

How to do the Heimlich maneuver

The Heimlich maneuver can be done in different ways, but it always depends on a quick upward thrust into the choking victim's abdomen. This movement forces air out of the lungs suddenly, which then forces the food or object out of the windpipe.

Most commonly, the victim is standing. If you are the rescuer, stand behind the victim and circle his or her waist with your arms. Make a fist (your thumb knuckle will stick up somewhat like a knob). Place the knob just above the person's navel. Hold your fist tightly with your other hand, and make quick, strong, upward thrusts into the victim's abdomen. Repeat the movement until the foreign object is dislodged and the person is able to breathe freely. (If the food or object does not fall out of the person's mouth, remove it carefully by hand to avoid re-inhaling.)

Make a fist with one hand, place the thumb against the abdomen, and make quick upward thrusts until the food or object is forced out of the windpipe.



To avoid rib injuries, use only your hands when helping the victim. Do not squeeze with your arms in a "bear hug." If the victim is sitting, you can perform the maneuver the same as you would if he or she were standing. If the victim is lying on the floor, make sure he or she is rolled face up. Then, kneel with your

Student Supplement 2

A Choking Child

legs on either side of the victim and perform the upward thrusts. (This approach works well for rescuers who are small or relatively weak.)

The Heimlich maneuver has saved thousands of lives, and it takes only a few minutes to learn.

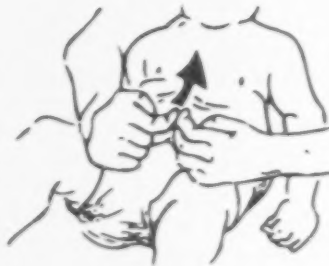
Small children are curious and often put things in their mouths. It is easy for a child to choke on a piece of food or part of a toy. Often, coughing will force the object out of the child's throat, but sometimes, natural reactions are not enough. With only four minutes after a child or adult stops breathing, death or permanent brain damage takes place.

Recognizing a choking child

A choking child may grab his or her throat. They will probably look terrified. If he or she is an older child, ask "Are you choking?" Even if he or she can't speak, they may be able to nod their head "yes." If a child is unconscious and not breathing (and you see no signs of physical injury) she may be choking.

How to do the Heimlich maneuver

When a young child is choking, use your fingers to push up firmly into the child's abdomen. This should force the object out of the windpipe.



The Heimlich maneuver can be done in different ways, but it always depends on quick upward thrusts to the abdomen. This forces air out of the lungs suddenly, which then forces the food or object out of the windpipe. When a child is choking, never try to remove the object by hand, or slap the child on the back. This can actually force the item further into the throat and may waste valuable time.

When you do the Heimlich maneuver on an older child, use your fist to perform the thrust.



Infants and young children

Place the child on your lap with his or her back to you. Put your index and middle fingers on both hands on the child's abdomen, slightly above the navel. Make sure your hands are not touching the rib cage. Make quick, firm thrusts into the child's abdomen. You may need to make as many as six thrusts, or it may just take one or two. You'll know the maneuver has worked if the child is now crying or breathing easily and the skin loses its bluish color. The food or object often pops out of the victim's mouth, but if it has not done so, remove it carefully yourself. (The same procedure can be performed with the child lying on his or her back on the floor.)

Older children

When you do the Heimlich maneuver on an older child, use your fist instead of your fingers to perform the thrust. The child can be standing, sitting, or lying down. First make a fist (your thumb's knuckle will stick up like a knob). Place the knob just above the child's navel. Hold your fist tight with your other hand, and make quick upward thrusts into the child's abdomen.

Student Supplement 3—Lifesaving Facts About Hypothermia

Hypothermia means lowered body temperature. It also can mean death to its victims if it is not prevented.

The danger of hypothermia comes from not knowing its symptoms or the conditions which can lead to its development. Ultimately, hypothermia saps the body's strength and energy. When the inner body becomes chilled sufficiently, the body can no longer generate enough heat to protect itself with a normal body temperature of around 98.6 degrees Fahrenheit. When this occurs — after violent shivering and mental stupor — the victim of hypothermia enters a state of tranquility, apathy, and uncontrollable sleepiness. Sleep brings a peaceful death. Many times, once hypothermia begins it is very difficult to reverse.

Hypothermia can start in wet conditions such as rain, snow, or sleet, but perspiration from exertion can start one on the way to hypothermia if wind conditions are right and sufficient clothing is not being worn. Even the humidity in the air can chill one enough to initiate hypothermia.

Most hypothermic deaths occur from accidentally falling into water during outdoor activities such as hunting, fishing, boating, or hiking. In the proper conditions, a boating accident which puts you in the water can take your life in much less than an hour — even if you are not injured.

Walking through the woods in wet conditions can soak clothing sufficiently that any wind can seriously lower body temperatures to the danger point. Any wind, even that generated by walking in cold, calm conditions, can cool the human body to dangerous levels. In short, if you become wet and chilled you are in danger.

Fatigue makes it harder for the body to generate heat, so people in poor physical condition or those who have been over exerting (such as those involved in boating accidents, those who have been running in a panic when they are lost, or those struggling to aid an injured companion) are the most likely candidates for hypothermic problems. Alcohol consumption also increases body heat loss because it increases the blood flow by dilating blood vessels.

The human body's automatic defense against the cold causes blood to flow from one's limbs to the inner organs and the brain to maintain consciousness and life. However, when the happens oxygen levels in the brain drop, causing impaired thinking. The victim begins to shiver and loses some control of arms and legs in the process. The shivering becomes severe and muscles begin to contract violently in spasms. Total loss of body control may follow. These conditions lead to falls and further problems.

To prevent hypothermia a person needs to know its causes and maintain the presence of mind to avoid careless mistakes and poor judgement calls.

- If you get wet, get out of the wind and weather. Change clothes, build a fire, and get warm.

Student Supplement 3

- Avoid over-exertion which leads to perspiring and fatigue.
- Dress in layers so you can adjust the amount of clothing you wear to meet the conditions in which you find yourself. Wool is an excellent outdoor clothing material. Wool maintains its ability to hold heat next to the body even if it is soaked.
- Carry protection from wind. A lined nylon windbreaker or light raincoat that allows your body to breathe while turning the rain will help prevent chills.
- Keep your head warm. Your face, neck, and head lose body heat faster than other parts of the body. Your sides and groin also lose heat quickly.
- In cold, wet conditions eat regularly and drink plenty of warm liquids. Do not consume alcohol in these conditions.

The following charts illustrate the dangers of prolonged exposure to cold water and to the dangers of frostbite in varying combinations of temperatures and wind.

Water Survival Chart		
If the Water Temp. (°F) is...	Exhaustion or Unconsciousness Occurs In...	Expected Time of Survival is...
32.0	Under 15 Minutes	Under 15-45 Minutes
32.5-40.0	15-30 Minutes	30-90 Minutes
40-50	30-60 Minutes	1-3 Hours
50-60	1-2 Hours	1-6 Hours
60-70	2-7 Hours	2-40 Hours
70-80	3-12 Hours	3-Indefinitely
over 80	Indefinitely	

Student Supplement 3

Wind Chill Index												
Estimated Wind Speed In MPH	Actual Thermometer Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
Calm	Equivalent Temperature (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-21	-38	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-36	-45	-58	-72	-88	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-124
25	30	16	0	15	-29	-44	-59	-74	-83	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-107	-128	-140
35	27	11	-4	-20	-35	-49	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	Little Danger* (for properly clothed person)				Increasing Danger*				Great Danger*			
	*Danger From Freezing of Exposed Flesh											

Student Supplement 4—Using Portable Fire Extinguishers

All portable fire extinguishers are labeled with picture and shape symbols. Each of the shape symbols (triangle, square, circle, and star) contain the letter of the fire class for which the extinguisher may be used on, but also tell what class(es) of fire the extinguisher should **not** be used on. All of this information, as well as directions for using the extinguisher, are also printed on the extinguisher. However, when a fire is discovered, speed is important, and, as the saying goes, "A picture is worth a thousand words." You should learn to be able to glance at the symbol on an extinguisher and know immediately whether the extinguisher is appropriate for the fire on hand.

Below are examples of fire-class shape symbols and their meanings, and examples of extinguisher picture symbols and their meanings.

Class A  Green • Ordinary combustibles 	Class B  Red • Flammable liquids and gases 
Class C  Blue • Live electrical equipment 	Class D  Yellow • Combustible metals 

Student Supplement 4

Remember the P-A-S-S sequence when using a portable fire extinguisher.

Pull the pin.

Aim the nozzle at the base.

Squeeze the handle.

Sweep the nozzle of the fire.

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Student Supplement 5—Using a Fire Extinguisher

Equipment,
and Materials

Using a portable fire extinguisher properly requires more than simple manipulation. You must always size up the fire and decide whether it can be extinguished with an extinguisher. If the fire is too large or too smoky, call the fire department. If the fire is small enough to be extinguished with an extinguisher, always fight it with your back to a means of escape.

- Portable fire extinguisher suitable for a Class A fire
- **Small** Class A fire in clear, safe area
- Charged hose (hose hooked up to a water source with water in the hose) or another secondary means of extinguishment for backup

Caution: This procedure should only be performed outdoors on a windless day and only under the direct supervision of your instructor.

Procedure

- ☐ 1. Pick up the fire extinguisher by its handle.

Note: All modern fire extinguishers are designed to be used in an **upright** position.

- ☐ 2. Read the fire extinguisher label to determine proper stream reach.

Note: *Stream reach* is the distance the extinguishing agent is propelled. Stream reach varies with extinguisher, and may range from 3 to over 20 feet. Normally, the smaller the extinguisher, the shorter the stream reach.

- ☐ 3. Walk—do not run—to within stream reach of the fire.

- ☐ 4. **Pull** the pin at the top of the extinguisher that keeps the handle from being pressed.

Note: Pulling the pin automatically breaks the plastic or thin wire inspection band.

- ☐ 5. **Aim** the nozzle toward the fire, first releasing it from its clip if applicable.

- ☐ 6. **Squeeze** the discharge handle (above the carrying handle) to release the extinguishing agent.

Note: The discharge handle can be released at any time to stop the discharge.

- ☐ 7. **Sweep** the nozzle back and forth at the base of the flames.

- ☐ 8. After the fire appears to be out, probe for remaining hot spots.

- ☐ 9. Make sure the fire is out by extinguishing any hot spots.

Student Supplement 6—Guidelines for Interpreting Material Safety Data Sheets

Living in the modern world, you probably are aware that the use of chemicals offers convenience and progress at home and work and outdoors. Naturally, you want to avoid dangerous overexposure to chemicals, especially on the job. Such overexposure is possible no matter where you work, even in an office or light industry.

Your company's hazard communications (HazCom) program was created to protect your health and safety. Three important elements are at the heart of your HazCom program: warning labels on containers, training on the safe use and handling of chemicals, and material safety data sheets (MSDSs).

What is on a MSDS

MSDSs are printed pages that give you all the critical information you need about how to use, transport, and store chemicals in order to protect yourself, as well as what to do in case of emergencies and overexposure. Information on MSDSs includes:

- The chemical's name or names
- Name, address, and phone number of the manufacturer.
- List of the chemical's ingredients.
- Permissible exposure limits (PEL) or threshold limit value (TLV)
- What conditions or other substances will cause the chemical to catch fire, explode, melt, or turn into dangerous gases
- How the chemical usually looks and smells
- How to put out a fire involving the chemical
- What to do if the chemical spills or leaks
- How to prevent dangerous exposure
- Health hazards such as skin irritant or cancer-causing agent
- Symptoms of overexposure
- What to do if you are overexposed
- When the MSDS was prepared

The information for each chemical's MSDS is put together by the manufacturer or distributor or that chemical. The sheets often look different from each other, but they still provide the same information. The law requires your employer to keep MSDSs up to date and to send the MSDS to your doctor or designated representative if you request it.

Where the MSDS is kept

MSDSs must be readily accessible to employees—a posted sign may tell you where, and you can also find out by reading your company's written HazCom program. If you are not sure where to find MSDSs, your supervisor or your company's HazCom contact will make them available to you. It is the law.

Student Supplement 6

When to read a MSDS

You should always read the MSDS *before* you begin a job using a chemical. Even if you have used the chemical before, the manufacturer may have changed its formula, which can change the steps you should take to protect yourself. Taking proper precautions listed on the MSDS, such as wearing a respirator, can prevent serious long-term illnesses.

If you do not understand something on the MSDS, or have questions about your company's HazCom program, ask your supervisor or company contact. Your contact knows that HazCom works best if you are fully informed and involved.

How to read a MSDS

The material safety data sheet, or MSDS, is written information that can help protect you from overexposure to chemicals you find on the job. The MSDS is part of your company's hazard communications program. Each company can design its own MSDS form, and the sections may be in a different order. But, the basic kinds of information on any MSDS will be the same.

Chemical name (see Figure 1). Lists the identity of the substance (the name on the label), date the MSDS was prepared, the name and address of the manufacturer, and usually a phone number for emergencies and more information.

Hazardous ingredients/chemical identity (see Figure 1). Includes names of substances in the chemical that might be dangerous, and lists safety exposure limits such as permissible exposure limit or PEL (set by OSHA) or the threshold value limit or TVL. Also lists common names for the chemical.

Physical characteristics (see Figure 1). Describes many physical qualities of the chemical, and lets you know what is usual or safe. For example, how the chemical looks and smells; boiling and melting temperatures (important in case a chemical might become a gas you could breathe); evaporation rate (known as *percent volatile*); how easily the chemical dissolves; and how heavy it is (this tells you if it will sink, float, or dissolve in water.)

Fire and explosion data (see Figure 1). Tells you the lowest temperature at which the chemical could catch fire (flash point). Lets you know if it is flammable (catches fire below 100°F) or combustible (catches fire above 100°F). Lists the best way to put out a fire involving that chemical.

Figure 1

The diagram shows a Material Safety Data Sheet (MSDS) form with the following sections and labels:

- Chemical name**: Points to the first section, labeled "SECTION 1: CHEMICAL IDENTIFICATION".
- Hazardous ingredients/chemical identity**: Points to the second section, labeled "SECTION 2: HAZARD IDENTIFICATION".
- Physical characteristics**: Points to the third section, labeled "SECTION 3: PHYSICAL AND CHEMICAL PROPERTIES".
- Fire and explosion data**: Points to the fourth section, labeled "SECTION 4: FIRE AND EXPLOSION DATA".

The form is titled "MATERIAL SAFETY DATA SHEET" at the top. A label "FRONT" is at the bottom right of the form.

Reactivity (see Figure 2). Describes what happens if this chemical comes in contact with air, water, or other chemicals. Describes conditions (like heat) or materials (like water) that can cause the chemical to react by burning, exploding, or releasing dangerous vapors. The chemical is called "incompatible" or "unstable" with these conditions or substances.

Health hazards (see Figure 2). Lists ways the chemical might enter your body, like splashing on your skin or being breathed in as vapor, as well as possible symptoms of overexposure. Lets you know if overexposure might make existing medical conditions worse, and describes emergency first aid procedures.

Usage, handling, and storage (see Figure 2). Describes how to clean up an accidental spill, leak, or release, including special procedures. Tells you how to handle, store, and dispose of chemicals safely. Remember, if there is an accident, notify your supervisor immediately. Take care of it yourself only if you are trained to do so and are wearing the proper equipment.

Special protection and precautions (see Figure 2). Explains special personal protective equipment (PPE) and other equipment to use when working with the chemical, special procedures, extra health or safety information, signs that should be posted, and other information not covered in other sections.

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Figure 2

The diagram shows a vertical stack of four rectangular boxes, each representing a section of an MSDS form. Arrows point from text labels to specific areas within these boxes: 'Reactivity' points to the top box, 'Health hazards' points to the second box, 'Usage, handling, and storage' points to the third box, and 'Special protection and precautions' points to the fourth box. Below the bottom box is a dark oval button with the word 'BACK' in white capital letters.

Terms and abbreviations used on MSDSs

The following terms and abbreviations will help you interpret materials safety data sheets.

- **TLV**—Threshold limit value; a time-weighted average concentration *under which* most people can work consistently for 8 hours a day, day after day with no harmful effects
- **Ceiling**—Uppermost limit
- **ACGIH**—American Conference of Governmental Industrial Hygienists
- **OSHA**—Occupational Safety and Health Act
- **PEL**—Permissible exposure limit; the maximum time-weighted concentration at *which* 95 percent of exposed, healthy adults suffer no adverse effects over a 40-hour week
- **ppm**—Parts per million
- **STEL**—Short-time exposure limit; a 15-minute, time-weighted average that should not be exceeded at any time during a workday. Exposures at STEL should not be longer than 15 minutes and should not be repeated more than four times a day with at least 60 minutes between exposures
- **IDLH**—Immediately dangerous to life and health; material at or above this level poses an immediate hazard to life or produces immediate, irreversible, debilitating effects
- **LEL**—Lower explosive limit; below the flammability range (too lean to burn)
- **UEL**—Upper explosive limit; below the flammability range (too rich to burn)

Student Supplement 7—Sample MSDSs

MSDS 1

*Cato Oil and Grease Co.*P.O. Box 26868
Oklahoma City, OK 73126

A SUBSIDIARY OF KERR-MCGEE CORPORATION

MATERIAL SAFETY DATA SHEET

MSDS NUMBER
C-7071

EMERGENCY TELEPHONE

COMPANY
405/424-3311CHEMTREC
800/424-9300

I. PRODUCT IDENTIFICATION

PRODUCT Cato Permanent Antifreeze and Summer Coolant	CHEMICAL NAME Ethylene Glycol
CHEMICAL FAMILY Ethylene Glycol	FORMULA Not Applicable
NATIONAL FIRE PROTECTION ASSOCIATION HAZARD Least-0 Slight-1 Moderate-2 High-3 Extreme-4	CAS NUMBER Mixture
HEALTH CODE 1	FIRE CODE 1
	REACTIVITY CODE 0

II. HAZARDOUS COMPONENTS

INGREDIENT	%	OSHA LIMIT	TLV
Ethylene Glycol & Glycols	94	Not Applicable	Ceiling 50 ppm
Inhibitors	6	Ingredients are proprietary Potential hazards have been evaluated and pertinent information has been included in Section IV-IX	
pH Approximately 11			

III. PHYSICAL AND CHEMICAL PROPERTIES

BOILING POINT >300°F	VAPOR PRESSURE <0.1 mm HG @68°F	EVAPORATION (ETHYL ETHER = 1) Slower
PERCENT VOLATILE BY VOLUME (%) Not Applicable	MOLECULAR WEIGHT Not Available	APPEARANCE Green Hygroscopic Liquid
ODOR AND THRESHOLD Not Applicable	MELTING POINT Not Available	VAPOR DENSITY (AIR = 1) 2.1
SPECIFIC GRAVITY (H ₂ O = 1) 1.1	VISCOSITY 24 Centistokes @20°C	SOLUBILITY (G/100G WATER AT 20°C) Infinitely Soluble

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MSDS 1

IV. FIRE PROTECTION INFORMATION

FLASH POINT AND METHOD Pensky-Martens Closed Cup 240°F	AUTOIGNITION TEMPERATURE 748°F	FLAMMABLE LIMITS % VOLUME IN AIR Not Available	LOWER 3.2	UPPER Not App.
---	-----------------------------------	---	--------------	-------------------

EXTINGUISHING MEDIA
Water spray, carbon dioxide, dry chemical, or foam.

HAZARDOUS DECOMPOSITION PRODUCTS

Incomplete combustion can yield carbon monoxide and carbon dioxide.

FIRE AND EXPLOSION HAZARDS

Not Applicable

HAZARDOUS POLYMERIZATION

☐ Will Not Occur ☐ May Occur

STABILITY

☒ Stable ☐ Unstable

V. HEALTH INFORMATION

INHALATION

Possible effects include nasal and respiratory irritation, drowsiness, narcosis, unconsciousness.

EYE CONTACT

Possible irritation with prolonged or repeated contact.

SKIN CONTACT

Possible irritation with prolonged or repeated contact.

INGESTION

Possible effects include liver or kidney damage, drowsiness, narcosis, unconsciousness, death.

REPORTED AS POTENTIAL CARCINOGEN OR CARCINOGEN

☒ Not Applicable
International Agency for Research on Cancer

☐ National Toxicology Program
CSHA

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MSDS 1

VI. FIRST AID PROCEDURES

INHALATION

Move exposed person to fresh air. If breathing has stopped, perform artificial respiration. Get medical as soon as possible.

EYE CONTACT

Immediately flush eyes with water for a minimum of 15 minutes, occasionally lifting the lower and upper lids. Get medical attention if redness or irritation occurs.

SKIN CONTACT

If clothing is soaked, immediately remove clothing and wash skin with soap and water. Launder clothing before wearing.

INGESTION

Give large quantities of water, then induce vomiting immediately. Get medical attention as soon as possible. Never give anything by mouth to an unconscious person.

VII. EMPLOYEE PROTECTION

RESPIRATORY PROTECTION (UTILIZE NIOSH APPROVED RESPIRATORS. REFER TO MANUFACTURER'S PROTECTION FACTORS AND OSHA STANDARD 1910.134 AS A GUIDELINE.)

Up to 500ppm ethylene glycol, full-face supplied air respirator.
Greater than 500ppm, fire fighting, or unknown concentration, self-contained breathing apparatus with positive pressure.

PROTECTIVE CLOTHING

EYE CONTACT

Safety glasses, chemical goggles, or face shield as appropriate for exposure.

SKIN CONTACT

For prolonged contact use rubber or neoprene gloves or other material resistant to ethylene glycol.

VENTILATION

Maintain local or dilution ventilation or keep air concentration below 500 ppm ethylene glycol. Request assistance of safety and industrial hygiene personnel to determine air concentration.

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MSDS 1

VIII. TRANSPORTATION AND STORAGE INFORMATION

DOT HAZARDOUS MATERIAL ☐ Yes ☒ No	
DOT SHIPPING NAME AND NUMBER Not Applicable	DOT HAZARD CLASS Not Applicable

STORAGE

Do not store with strong oxidizers.

IX. ENVIRONMENTAL PROTECTION

SPILLS	Notify emergency response personnel. Build dike to contain flow Remove free liquid, do not flush to sewer or open water Pick up with inert absorbent and place in closed container for disposal		
WASTE DISPOSAL	EPA HAZARDOUS WASTE ☐ Yes ☒ No	EPA WASTE CODE NUMBER Not Applicable.	WASTE CHARACTERISTIC OR HAZARD CODE Not Applicable
	Utilize licensed waste disposal company. Utilize permitted industrial waste disposal site.		
SIGNATURE		DATE PREPARED	

DISCLAIMER

The information and recommendations contained in this publication have been compiled from sources believed to be reliable and to represent the best current opinion on the subject at the time of publication. Since we cannot anticipate or control the many different conditions under which this information or our products may be used, we make no guarantee that the recommendations will be adequate for all individuals or situations. Each user of the product described herein should determine the suitability of the described product for a particular purpose and should comply with all federal and state rules and regulations concerning the described product.

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MSDS 2

MATERIAL SAFETY DATA SHEET

Emergency Phone 1-800-424-9300

Green Light**Products:** Sevin 5% Dust**EPA Registration:** 869-118**Trade/Common Chemical Name:** "SEVIN" BRAND 97.5% TECHNICAL**Manufacturer:** Rhone-Poulenc Ag Company**Effective Date:** 01/01/92**1. INGREDIENTS:**

Carbaryl, (1-Naphthyl N-methylcarbamate) 97.5% by wt Cas# 63-25-2

2. PHYSICAL DATA:

BOILING POINT: n/a

VAPOR PRESSURE: Less than 0.000040 mm Hg

SOL. IN WATER: 40 ppm @ 30C

MELTING POINT: 288F (142C)

APPEARANCE: White or light tan solid

ODOR: Mild phenolic odor

3. FIRE AND EXPLOSION HAZARD DATA:

FLASH POINT: 380F (193C)

METHOD USED: Cleveland Open Cup

FLAMMABLE LIMITS: Lower: 0.02 ounces/cubic foot, Upper: Not known

EXTINGUISHING MEDIA: Dry chemical or CO₂ for small fires; water spray or foam for large fires.

FIRE AND EXPLOSION HAZARDS: Thermal decomposition products may be hazardous. These may include oxides of nitrogen and carbon small amounts of methyl isocyanate. Avoid dispersion of dust in air to reduce potential explosion hazard. Use electrical equipment suitable for atmospheres that may contain combustible dusts.

FIRE-FIGHTING EQUIPMENT PROCEDURES: Evacuate residents who are downwind of fire. Prevent unauthorized entry to fire area. Firemen should wear protective clothing and use self-contained breathing apparatus. Anyone who may have been exposed to contaminated smoke should be immediately checked for symptoms of poisoning. These should not be mistaken for heat exhaustion or smoke inhalation. Dike area to prevent runoff and contamination of water sources.

4. REACTIVITY DATA:

STABILITY: Stable

Avoid extended storage at temperatures in excess of 100F (37.8C)

INCOMPATIBILITY (Specific materials to avoid): Alkalies, strong acids

HAZARDOUS DECOMPOSITION PRODUCTS: Oxides of nitrogen and carbon and minute quantities of methyl isocyanate may be produced upon thermal decomposition.

5. ENVIRONMENTAL AND DISPOSAL INFORMATION:

ACTION TO TAKE FOR SPILLS/LEAKS: Sweep or shovel spills into waste container while minimizing dust generation. Wear appropriate personal protective equipment. Do not contaminate water sources.

DISPOSAL METHOD: Dispose of in an approved landfill or incinerator following all applicable federal, state, and local regulations.

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MSDS 2

6. HEALTH HAZARD DATA:

EYES: Dusts or sprays (mists) may cause eye irritation, seen as tearing and redness.

SKIN CONTACT: Minimal irritation. Dermal LD50 rabbit: 2000 mg/kg.

SKIN ABSORPTION: Harmful if absorbed through skin. May lead to symptoms as described for ingestion.

INGESTION: May be fatal if swallowed. Oral LD50 rats: 264 mg/kg.

May lead to rapid onset of nausea, vomiting, abdominal pain, diarrhea, pinpoint pupils, blurred vision, profuse sweating, salivation, tremors, muscle twitching, and temporary paralysis. In severe poisoning respiratory depression and convulsions may occur.

INHALATION: Harmful if inhaled. Inhalation of dusts or sprays (mists) may lead to symptoms as described for ingestion. May be irritating to the respiratory tract.

LC50 (rat - 4 hr exposure): 2.50 mg/l.

SYSTEMIC & OTHER EFFECTS: Repeated overexposure may cause more severe cholinesterase inhibition with the signs and symptoms being more pronounced. Skin irritation may be aggravated in persons with existing skin lesions. Breathing of vapor, dust, or sprays (mists) may aggravate asthma and inflammatory or fibrotic pulmonary disease. Overexposure may aggravate existing chronic cardiovascular or respiratory disease leading to respiratory difficulty, pulmonary edema and cyanosis.

7. FIRST AID:

PRECAUTION: Persons attending the victim should avoid direct contact with heavily contaminated clothing and vomitus. Wear impervious gloves while decontaminating skin and hair. Remove the patient from immediate source of exposure and assure that the individual is breathing.

EYES: Hold eyelids open and flush with a steady, gentle stream of water for at least 15 minutes. GET MEDICAL ATTENTION.

SKIN: Immediately wash skin with plenty of soap and water, if available, while removing contaminated clothing and shoes. Wash clothing separately before reuse.

INGESTION: If patient is conscious and alert, give 2-3 glasses of water or milk to drink. If available, give one tablespoon of syrup of ipecac to induce vomiting. Alternately, induce vomiting by touching back of throat with finger. Do not repeat the syrup of ipecac. Do not make an unconscious person vomit. GET MEDICAL ATTENTION.

NOTES TO PHYSICIAN: All treatments should be based on observed signs and symptoms of distress in the patient. Overexposure to materials other than this product may have occurred.

This product contains a methyl carbamate insecticide, which is a cholinesterase inhibitor.

Overexposure to this substance may cause toxic symptoms due to stimulation of the cholinergic nervous system. These effects of overexposure are spontaneously and rapidly reversible.

Specific treatment consists of parenteral atropine sulfate. Improve tissue oxygenation as much as possible before administering atropine to minimize the risk of ventricular fibrillation. Mild cases may be given 1-2 mg intramuscularly every 10 minutes until full atropinization has been achieved and repeated thereafter whenever symptoms reappear. Severe cases should be given 2-4 mg intravenously every 10 minutes until fully atropinized, then intramuscularly every 30-60 minutes as needed to maintain the effect for at least 12 hours. Dosages for children should be appropriately reduced. Caution should be maintained to prevent overatropinization. Complete recovery from overexposure is to be expected within 24 hours.

Narcotics and other sedatives should not be used. Further, drugs like 2-PAM (pyridine-2-aldoxime methiodide) are NOT recommended.

To aid in confirmation of a diagnosis, urine samples should be obtained within 24 hours of exposure and immediately frozen. Analysis will be arranged by Rhone-Poulenc Ag Company.

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MSDS 2

8. **HANDLING PRECAUTIONS:**

EXPOSURE GUIDELINES: Carbaryl: 5 mg/m³ air TLV-TWA (ACGIH) and PEL-TWA (OSHA)

VENTILATION: Mechanical (general) ventilation

RESPIRATORY PROTECTION: Use NIOSH/MSHA approved respirator for pesticide dust when handling spills or leaks, or when airborne concentrations exceed allowable exposure limits.

SKIN PROTECTION: Chemical-resistant gloves, full-body protective clothing, safety shower.

EYE PROTECTION: Goggles, eye bath.

9. **ADDITIONAL INFORMATION:**

SPECIAL PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Do not ingest. Avoid inhaling dusts or sprays (mists). Avoid getting in eyes, on skin, or on clothing. Store unused product in original container only, in cool, dry area out of reach of children and animals. Do not store in areas where temperatures frequently exceed 100F. Do not contaminate water, food, or feed by storage or disposal.

All information appearing herein is based upon data obtained from the manufacturer and/or recognized technical sources. While the information is believed to be accurate, Green Light makes no representations as to its accuracy or sufficiency. Conditions of use are beyond Green Light's control. Therefore, users are responsible for determining whether under their own operating conditions the product is suitable for their particular use. Users assume all risks of use, handling, and disposal of product. The publication or use of, or reliance upon, information contained herein does not relate to the use of this product with any other material or in any other process.

MSDS 3

GRACE		AMMONIUM NITRATE	
		IDENTIFIER (Common Name)	
MATERIAL SAFETY DATA SHEET			
MANUFACTURER'S NAME W.R. Grace & Co., Ag Chem Group		EMERGENCY TELEPHONE NO. 919-763-0171	
ADDRESS 100 N. Main Street P.O. Box 277 Memphis, TN 38101		OTHER INFORMATION 1-800-424-9300 CHEMTREC	
PREPARED BY W.R. Grace & Co., Ag Chem Group		DATE PREPARED 9-18-85	
SECTION 1 — PRODUCT IDENTIFICATION			
COMMON NAME (Based on Label, Trade Name, and Synonyms): Ammonium Nitrate			
CHEMICAL NAME(S): Ammonium Nitrate		CAS NO 5484-52-2	
SECTION 2 — HAZARDOUS INGREDIENTS MIXTURE: ☒ Yes ☐ No			
PRIMARY HAZARDOUS COMPONENT(S) AND COMMON NAME(S)	% RANGE	OSHA PERMISSIBLE EXPOSURE LIMIT	ACGIH THRESHOLD LIMIT VALUE
Ammonium Nitrate	97-99	NA	NA
SECTION 3 — PHYSICAL AND CHEMICAL CHARACTERISTICS (Fire and Explosion Data)			
BOILING POINT	Decomposes at 410°F	SPECIFIC GRAVITY (H ₂ O = 1)	1.72 @ 70°F
PERCENTILE VOLATILE BY VOLUME (%)	NA	VAPOR DENSITY (AIR = 1)	NA
SOLUBILITY IN WATER	192g/100cc @ 68°F	REACTIVITY IN WATER	NA
APPEARANCE AND ODOR	Solid, white color, and odorless		FLASH POINT
FLAMMABLE LIMITS BY AIR % BY VOLUME	LOWER NA	UPPER NA	AUTO IGNITION TEMP: NA
EXTINGUISHING MEDIA		Water	
SPECIAL FIRE FIGHTING PROCEDURES: Flood melted and burning ammonium nitrate with large volumes of low pressure water. Do not smother fire. Do not add steam, carbon dioxide, dry chemicals, foam extinguishers, or other smothering agents. Do not use salt water. Fight fire from protected location as steam eruptions are common and ammonium nitrate splashes are possible.			
UNUSUAL FIRE AND EXPLOSION HAZARDS: Nitrogen oxide gases emitted on decomposition are extremely toxic. Consideration must be given to change contamination of ammonium nitrate with oil, charcoal, sulfur, metal fines, or other combustible substances with possible explosion of entire mass. If an explosion is suspected, surrounding areas should be evacuated.			

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SECTION 4 — PHYSICAL HAZARDS			
HAZARDOUS COMPONENTS:		Ammonium Nitrate	
STABILITY:	☒ Stable ☐ Unstable	Conditions to Avoid: Avoid contamination with oxidizable matter. (See List Below)	
INCOMPATIBILITY:		Avoid mixing ammonium nitrate with oxidizable materials (wood chips, organic materials, sulfur, chlorides, phosphorus, finely divided metals, acids, flammable liquids, charcoal).	
(MATERIALS TO AVOID):			
HAZARDOUS DECOMPOSITION PRODUCTS:		On heating decomposes to ammonia, nitric acid, and oxides of nitrogen.	
HAZARDOUS POLYMERIZATION:	☒ May Occur ☐ Will Not Occur	Conditions to Avoid: NA	
OTHER HAZARDS:		Oxidizer	
SECTION 5 — HEALTH HAZARDS			
HAZARDOUS COMPONENTS:		None	
SIGNS AND SYMPTOMS OF EXPOSURE:			
1. ACUTE OVEREXPOSURE:		If ingested, cyanosis, decrease in blood pressure, rapid heartbeat, rapid breathing, abdominal pain, weakness, and collapse can occur.	
2. CHRONIC OVEREXPOSURE:		Small repeated oral doses may lead to weakness, general depression, headache, and mental impairment.	
MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE:		Large doses may cause nausea and vomiting. Acidosis may occur in the presence of impaired renal function and also during prolonged use in persons with normal kidney function.	
CHEMICAL LISTED AS CARCINOGEN OR POTENTIAL CARCINOGEN:		NATIONAL TOXICOLOGY PROGRAM: ☐ Yes ☒ No	IARC MONOGRAPHS: ☐ Yes ☒ No OSHA: ☐ Yes ☒ No
EMERGENCY AND FIRST AID PROCEDURES:			
Flush exposed area with water. Remove to fresh air. If ingested, administer water, milk, and raw eggs to make vomit.			
ROUTE(S) OF ENTRY:			
1. INHALATION: Inhaled dust may cause minor respiratory tract irritation.			
2. EYES: May be irritating.			
3. SKIN: Slightly irritating.			
4. INGESTION: Ingestion of 8 to 15 grams of nitrate salt, may cause methemoglobinemia—chemical cyanosis. Classified as non-toxic.			
SECTION 6 — SPECIAL PROTECTION INFORMATION			
MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE:		A NIOSH/MSHA approved dust respirator should be used when exposure exceeds the CSHA nuisance dust standard.	
VENTILATION:		Provides local or general ventilation to keep dust below OSHA nuisance dust limit of 15 mg/m ³ . VENTILATION: NA	
PROTECTIVE GLOVES:		No protection normally required. If irritation occurs, long sleeves and impervious gloves should be worn. EYE PROTECTION: Safety goggles should be worn if irritation exist.	
OTHER PROTECTIVE CLOTHING OR EQUIPMENT:			
None			

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MSDS 3

SECTION 7 —SPECIAL PRECAUTIONS AND SPILL LEAK PROCEDURES

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

Store in cool, well ventilated area away from acute fire hazards and combustible materials. Avoid contamination. Floor drains and recesses should be plugged or eliminated to prevent entrapment of flowing, molten nitrate during fire.

OTHER PRECAUTIONS

Bagged ammonium nitrate is subject to storage, stacking, and quantity regulations. Follow Federal, State, and Local regulations. Detailed requirements are given in CFR 1910.109.

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Contain large spill to prevent contact with waterways or vegetation. Prevent contamination with combustibles and keep away from heat.

The information, data, and recommendations in this material safety data sheet relate only to the specific material designated herein and do not relate to use in combination with any other material or in any process. The information, data, and recommendations set forth herein are believed by W.R. Grace & Co. to be accurate. W.R. Grace & Co. makes no warranties, either expressed or implied, with respect therein and assumes no liability in connection with any use of such information, data, and recommendations.

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MSDS 4



MATERIAL SAFETY DATA SHEET

97367 14-851

MSDS NUMBER →

201,750-3

PAGE 1

24 HOUR EMERGENCY ASSISTANCE			GENERAL MSDS ASSISTANCE			BE SAFE READ OUR PRODUCT SAFETY INFORMATION AND PASS IT ON (PRODUCT LIABILITY LAW REQUIRES IT)
SHELL: 713-473-9461 CHEMTREC: 800-424-9300			SHELL: 713-241-4819			
ACUTE HEALTH 2	FIRE 0	REACTIVITY 0	HAZARD RATING →			
			LEAST - 0	SLIGHT - 1	MODERATE - 2	
			HIGH - 3			EXTREME - 4
*For acute and chronic health effects refer to the discussion in Section III						

SECTION I	NAME
PRODUCT →	ATRAZINE 4L
CHEMICAL NAME →	2-CHLORO-4, 6BISPROPYLAMINO-S-TRIAZINE
CHEMICAL FAMILY →	AGRICULTURAL CHEMICAL
SHELL CODE →	14230

SECTION II-A		PRODUCT/INGREDIENT	
NO.	COMPOSITION	CAS NUMBER	PERCENT
P	ATRAZINE 4L AATREX	MIXTURE	100
1	TECHNICAL ATRAZINE	1912-24-9	43.4
2	INERT FORMULATION COMPONENTS		56.6

* THE SPECIFIC CHEMICAL IDENTITY OR PERCENT N COMPOSITION OF COMPONENT 2 IS CONSIDERED TRADE SECRET INFORMATION. COMPONENT 2 CONTAINS ETHYLENE GLYCOL.

SECTION II-B		ACUTE TOXICITY DATA	
NO.	ACUTE ORAL LD50	ACUTE DERMAL LD50	ACUTE INHALATION LC50
P	1.06-1.69 ML/KG (RAT)	>2.0 ML/KG (RAT)	
1			>710 MG/L (RAT)

SECTION III		HEALTH INFORMATION	
THE HEALTH EFFECTS NOTED BELOW ARE CONSISTENT WITH REQUIREMENTS UNDER THE OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200).			

EYE CONTACT

BASED ON PRODUCT TESTING, PRODUCT IS MILDLY IRRITATING TO THE EYES.

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MSDS 4

PRODUCT NAME: ATRAZINE 4L

MSDS 201,750-3

PAGE 2

SKIN CONTACT

BASED ON PRODUCT TESTING, PRODUCT IS MINIMALLY IRRITATING TO THE SKIN.

INHALATION

BASED ON THE PRESENCE OF COMPONENT 2, VAPORS ARE MILDLY TO MARKEDLY IRRITATING TO THE LUNGS DEPENDING ON THE EXPOSURE LEVEL.

INGESTION

BASED ON PRODUCT TESTING, PRODUCT IS MODERATELY TOXIC AND MAY BE HARMFUL IF SWALLOWED. BASED ON THE PRESENCE OF COMPONENT 2, MAY PRODUCE CENTRAL NERVOUS SYSTEM (CNS) DEPRESSION AND KIDNEY DAMAGE WHICH MAY BE FATAL.

SIGNS AND SYMPTOMS

IRRITATION AS NOTED ABOVE. KIDNEY DAMAGE MAY BE EVIDENCED BY CHANGES IN URINE OUTPUT, URINE APPEARANCE OR EDEMA (SWELLING FROM LIQUID FLUID RETENTION).

AGGRAVATED MEDICAL CONDITIONS

PREEXISTING EYE, SKIN AND RESPIRATORY DISORDERS MAY BE AGGRAVATED BY EXPOSURE TO THIS PRODUCT. IMPAIRED KIDNEY FUNCTIONS FROM PREEXISTING DISORDERS MAY BE AGGRAVATED BY EXPOSURE TO THIS PRODUCT.

OTHER HEALTH EFFECTS

IN TESTING OF COMPONENT 1, ATAXIA, DYSPNEA, AND CONVULSIONS HAVE BEEN NOTED IN LETHALLY INTOXICATED EXPERIMENTAL ANIMALS.

SECTION IV

OCCUPATIONAL EXPOSURE LIMITS

NO.	OSHA		ACGIH		OTHER
	PEL/TWA	PEL/CEILING	TLV/TWA	TLV/STEL	
1			5 MG/M ³		

SECTION V

EMERGENCY AND FIRST AID PROCEDURES

EYE CONTACT

FLUSH EYES WITH PLENTY OF WATER FOR 15 MINUTES WHILE HOLDING EYELIDS OPEN. GET MEDICAL ATTENTION.

SKIN CONTACT

REMOVE CONTAMINATED CLOTHING/SHOES AND WIPE EXCESS FROM SKIN. FLUSH SKIN WITH WATER. FOLLOW BY WASHING WITH SOAP AND WATER. IF IRRITATION OCCURS, GET MEDICAL ATTENTION. DO NOT REUSE CLOTHING UNTIL CLEAN.*

INHALATION

REMOVE VICTIM TO FRESH AIR AND PROVIDE OXYGEN IF BREATHING IS DIFFICULT. GIVE ARTIFICIAL RESPIRATION IF NOT BREATHING. GET MEDICAL ATTENTION.

INGESTION

DO NOT GIVE LIQUIDS IF VICTIM IS UNCONSCIOUS OR VERY DROWSY. OTHERWISE, GIVE NO MORE THAN 2 GLASSES OF WATER AND INDUCE VOMITING BY GIVING 30CC (2 TABLESPOONS) SYRUP OF IPECAC.** IF IPECAC IS UNAVAILABLE, GIVE 2 GLASSES OF WATER AND INDUCE VOMITING BY TOUCHING FINGER TO BACK OF VICTIM'S THROAT. KEEP VICTIM'S HEAD BELOW HIPS WHILE VOMITING. GET MEDICAL ATTENTION.

NOTE TO PHYSICIAN

** IF VICTIM IS A CHILD, GIVE NO MORE THAN 1 GLASS OF WATER AND 15CC (1 TABLESPOON) SYRUP OF IPECAC. IF SYMPTOMS SUCH AS LOSS OF GAG REFLEX, CONVULSIONS, OR UNCONSCIOUSNESS OCCUR BEFORE EMESIS, GASTRIC LAVAGE SHOULD BE CONSIDERED FOLLOWING INTUBATION WITH A CUFFED ENDOTRACHEAL TUBE.

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MSDS 4

PRODUCT NAME: ATRAZINE 4L

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SECTION VI SUPPLEMENTAL HEALTH INFORMATION

THE ACTIVE INGREDIENT WAS ADMINISTERED IN A CHRONIC FEEDING TO RATS AT 0, 10, 300, AND 1000 PPM. NO COMPOUND RELATED EFFECTS WERE NOTED IN ANY OF THE TREATMENT GROUPS FOR GROSS PATHOLOGY OR HISTOPATHOLOGY. TERATOLOGY STUDIES IN RATS AND RABBITS WERE NEGATIVE.

IN ONE STUDY, WHEN ETHYLENE GLYCOL WAS ADMINISTERED IN THE DIET AT DAILY DOSES UP TO 1.0 G/KG TO PREGNANT RATS, NO MATERNAL TOXICITY, NO EMBRYOTOXICITY NOR TERETOGENICITY WERE OBSERVED. IN A MORE RECENT STUDY, WHEN ETHYLENE GLYCOL WAS ADMINISTERED BY GAVAGE AT DAILY DOSES OF 1.25 G/KG AND ABOVE TO PREGNANT RATS, OR A 750 MG/KG AND ABOVE TO PREGNANT MICE, THERE WAS AN INCREASE IN THE NUMBER OF MALFORMED FETUSES AT ALL DOSE LEVELS. EXCEPT AT THE LOWEST DOSE LEVEL IN MICE, THERE WAS ALSO EVIDENCE OF MATERNAL TOXICITY AT ALL DOSE LEVELS.

SECTION VII PHYSICAL DATA

BOILING POINT: NOT AVAILABLE
(DEG F)

SPECIFIC GRAVITY: 1.11
(H₂O = 1)

VAPOR PRESSURE: NOT AVAILABLE
(MM HG)

MELTING POINT: NOT APPLICABLE
(DEG F)

SOLUBILITY: DISPERSIBLE
(IN WATER)

VAPOR DENSITY: NOT AVAILABLE
(AIR = 1)

EVAPORATION RATE (N-BUTYL ACETATE = 1): NOT AVAILABLE

APPEARANCE AND ODOR: WHITE, MOBILE LIQUID.

SECTION VIII FIRE AND EXPLOSION HAZARDS**FLASH POINT AND METHOD:**

WILL NOT BURN

FLAMMABLE LIMITS / % VOLUME IN AIR

LOWER: N/AP

UPPER: N/AP

EXTINGUISHING MEDIA

USE WATER FOG, FOAM, DRY CHEMICAL OR CO₂.

SPECIAL FIRE FIGHTING PROCEDURES AND PRECAUTIONS

MATERIAL WILL NOT BURN UNLESS PREHEATED. DO NOT ENTER CONFINED FIRE SPACE WITHOUT FULL BUNKER GEAR (HELMET WITH FACE SHIELD, BUNKER COATS, GLOVES, AND RUBBER BOOTS), INCLUDING A POSITIVE PRESSURE NIOSH APPROVED SELF-CONTAINED BREATHING APPARATUS. COOL FIRE EXPOSED CONTAINERS WITH WATER.

UNUSUAL FIRE AND EXPLOSION HAZARDS

NITROGEN OXIDES AND NITROGEN CONTAINING ORGANIC COMPOUNDS MAY BE RELEASED UPON COMBUSTION.

SECTION IX REACTIVITY

STABILITY: STABLE

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS AND MATERIALS TO AVOID:

NITROGEN OXIDES, CARBON MONOXIDE, AND UNIDENTIFIED ORGANIC COMPOUNDS MAY BE FORMED DURING COMBUSTION.

HAZARDOUS DECOMPOSITION PRODUCTS

NITROGEN OXIDES, CARBON MONOXIDE, AND UNIDENTIFIED ORGANIC COMPOUNDS MAY BE FORMED DURING COMBUSTION.

Student Supplement 7

MSDS 4

PRODUCT NAME: ATRAZINE 4L

MSDS 201,750-3

PAGE 4

SECTION X EMPLOYEE PROTECTION

RESPIRATORY PROTECTION

IF EXPOSURE MAY OR DOES EXCEED OCCUPATIONAL EXPOSURE LIMITS (SEC. IV) USE A NOISH-APPROVED RESPIRATOR TO PREVENT OVEREXPOSURE. IN ACCORD WITH 29 CFR 1910.134 USE EITHER AN ATMOSPHERE-SUPPLYING RESPIRATOR OR AN AIR-PURIFYING RESPIRATOR FOR PARTICULATES.

PROTECTIVE CLOTHING

AVOID CONTACT WITH EYES, WEAR SAFETY GLASSES OR GOGGLES AS APPROPRIATE. AVOID CONTACT WITH SKIN AND CLOTHING. WEAR CHEMICAL-RESISTANT GLOVES AND PROTECTIVE CLOTHING.

SECTION XI ENVIRONMENTAL PROTECTION

SPILL OR LEAK PROCEDURES

MAY BURN ALTHOUGH NOT READILY IGNITABLE. USE CAUTIOUS JUDGMENT WHEN CLEANING UP LARGE SPILLS. ***LARGE SPILLS—WEAR RESPIRATOR AND PROTECTIVE CLOTHING AS APPROPRIATE. SHUT OFF SOURCE OF LEAK IF SAFE TO DO SO, DIKE AND CONTAIN. REMOVE WITH VACUUM TRUCKS OR PUMP TO STORAGE/SALVAGE VESSELS. SOAK UP RESIDUE WITH AN ABSORBENT SUCH AS CLAY, SAND, OR OTHER SUITABLE MATERIAL. DISPOSE OF PROPERLY. FLUSH AREA WITH WATER TO REMOVE TRACE RESIDUE.

***SMALL SPILLS—TAKE UP WITH AN ABSORBENT MATERIAL AND DISPOSE OF PROPERLY. FOR DISPOSAL SEE BELOW

WASTE DISPOSAL

PLACE IN AN APPROPRIATE DISPOSAL FACILITY IN COMPLIANCE WITH LOCAL REGULATIONS. CONSULT PRODUCT LABEL FOR SPECIFIC DISPOSAL INSTRUCTIONS.

SECTION XII SPECIAL PRECAUTIONS

STORE IN A COOL, DRY PLACE WITH ADEQUATE VENTILATION. KEEP AWAY FROM OPEN FLAMES AND HIGH TEMPERATURES.

SECTION XIII TRANSPORTATION REQUIREMENTS

DEPARTMENT OF TRANSPORTATION CLASSIFICATION: NOT HAZARDOUS BY D.O.T. REGULATIONS

SECTION XIV OTHER REGULATORY CONTROLS

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DATE PREPARED: NOVEMBER 21, 1985

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SAFETY INFORMATION, AND PASS IT ON
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JOHN P. PEPESI

SHELL OIL COMPANY
PRODUCT SAFETY AND COMPLIANCE
P.O. BOX 4320
HOUSTON, TX 77210

Unit 2

Natural Resources and Conservation

Unit Contents

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Objective Sheet

Unit
Objective

After completing this unit, the student should be able to explain the importance of natural resources and distinguish between renewable and nonrenewable resources and preservation and conservation of natural resources. The student should demonstrate these competencies by completing the assignment sheets and by scoring a minimum of 85 percent on the written test.

Specific
Objectives

After completing this unit, the student should be able to:

1. Match terms related to natural resources and conservation with their definitions.
2. Explain the difference between renewable and nonrenewable natural resources.
3. Name the four basic components of the physical environment.
4. Select true statements concerning the history of natural resources.
5. Explain the importance of natural resources.
6. Give four examples of conflicts in natural resource management.
7. List four factors which affect natural resources.
8. Distinguish between preservation and conservation of natural resources.
9. List preservation activities.
10. List two activities to conserve each of the natural resources.
11. Match categories of solid waste with the descriptions.
12. Select true statements concerning the composition of solid waste in a typical municipal landfill.
13. Complete statements concerning methods of waste disposal.
14. Select true statements concerning waste reduction activities.
15. Distinguish between recyclables and nonrecyclables.
16. Match federal agencies responsible for natural resources with their descriptions.
17. List types of occupations in natural resources.
18. List ways of getting a job in natural resources.

Objective Sheet

19. List characteristics of a person working in natural resources.
20. Report on a current event affecting natural resources.
(Assignment Sheet 1)
21. Report on a local natural resource problem. (Assignment Sheet 2)
22. Identify recycling centers in your area. (Assignment Sheet 3)
23. Trace route of recyclable products. (Assignment Sheet 4)
24. Identify occupations in natural resources in your area.
(Assignment Sheet 5)

Information Sheet

Introduction

The purpose of this course is to present a balanced viewpoint of the place of humans in the world as long-term residents. You will study outdoor safety and first aid, natural resources and conservation, water resource management, land management, air resource management, energy resources, forestry, wildlife management, wildlife habitats, and outdoor recreation. Because the management of natural resources is a very broad topic, this course will be used as a survey of the many broad areas.

There are many different ways to look at the management of our natural resources. Three different viewpoints that must be considered are those of the preservationist, the exploiter, and the conservationist.

From the preservationist's perspective, humankind is a great destroyer and pillager, and we have no right to destroy the land or tear the earth apart. Nature is something to be left alone.

If we take the viewpoint of the exploiter, natural resources are merely a source of wealth and power. They represent something that is there for the taking and for our own use. A natural resource is something to be reshaped for our economic benefit, with little regard for other creatures in the ecosystem.

The conservationist viewpoint is somewhere between those two. From the conservationist's perspective, nature provides resources that should be used carefully for our collective economic benefit. A conservationist would encourage the harvesting of forests to produce wood and paper as long as the trees are replaced by other trees having economic value, but not necessarily the same kind of tree harvested originally. A conservationist would allow the strip mining of coal as long as the land is restored to a balanced, natural state when the mining is completed and as long as no meaningful collateral environmental damage occurred during the process.

Which viewpoint is right and which is wrong? There is no simple answer to such a question. What can be said for certain is that the world is not a very large place, and there are many people. As the number of people on Earth continues to increase, the pressure applied to our natural resources and our environment increases. It is important that we understand what effect our decisions to use available natural resources will have on our environment and how our decisions will impact future generations.

Information Sheet

Objective 1

Terms and definitions

Biodegradable	Hazardous (toxic) waste
Degradation	Natural resources
Depletion	Ozone (O ₃) layer
Ecosystem	Pollutant
Ecologist	Pollution
Endangered species	Protected species
Environmental impact	Recycling
Fossil fuels	Urbanization
Global	Waste

Objective 2

Types of natural resources

Key term:

- **Natural resources**—Land, water, air, wildlife, sunlight, and human labor

Note: Resources are defined as anything that can be relied upon to fill a need. **Natural resources**, therefore, would be those things in nature upon which human depend for food, shelter, clothing, transportation, and recreation.

- Renewable natural resources—Resources which can be replaced after they have been used.

Examples:

- **Plants**—Trees can be cut for lumber; then small seedlings can be planted to replace them. Most paper products come from forest plots, planted specifically for harvest for paper mills. Grass can be cut for animal forage and replaced by nature.

Figure 1



- **Animals**—Livestock, fish, and game animals can be used for food and replaced by reproduction and relocation.

Note: Although animals reproduce naturally and their populations respond to various pressures applied to them, if their natural cycles and habitats are severely damaged, they can become extinct.

- b. **Nonrenewable natural resources**—Resources which cannot be replaced in a lifetime after they are used.

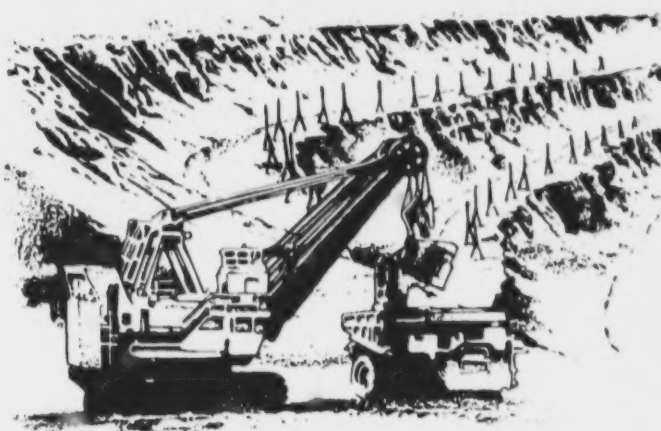
Key term:

- **Fossil fuels**—Hydrogen compounds derived from the remains of organisms buried millions of years ago

Examples:

- **Fossil fuels**—Formed by decaying vegetation (coal) and animal life (oil and gas)

Figure 2



- Soil and other minerals such as sand, iron, lead, gold, and aluminum that are formed by different arrangements of atoms in the earth's crust.

Objective 3

Basic components of the physical environment

Key term:

- **Pollutant**—Harmful waste that contaminates the air, water, and soil and reduces the quality of the environment
- a. Air
- Is vital to plants and animals for respiration (oxygen/carbon dioxide exchange)
 - Can be contaminated by **pollutants** from industry, automobiles, and dust from construction, agricultural, and other human activities

Information Sheet

Objective 4

b. Water

- Is vital to all organisms
- Can be contaminated by sewage, industrial waste, runoff from unprotected soil, and municipal storm runoff

c. Soil (and its minerals)

- Is critical to all life because it supports vegetation which begins the food chain
- Forms very slowly; may take thousands of years to produce enough to sustain vegetation
- Can be destroyed or dislocated by wind, floods, and human activities such as construction, farming, logging, and mining

d. Sunlight

- Is critical to all life which needs light and heat
- Is the basic source of all energy on earth

History of natural resources

Key term:

- **Global**—Involving the world

- Humans have always used natural resources.
- Industrial progress is built on the use (and sometimes abuse) of many natural resources
- When world and national populations were small, natural resources were so abundant there was little need for conservation of natural resources.
- As populations increased, natural resources tend to become scarce.

Note: In the year 2000, world population reached and now exceeds six (6) billion people

- Proper management of natural resources is necessary to prevent their depletion.
- Management of natural resources has become a **global** issue and countries are working together to address such issues as global warming and wildlife conservation as well as conservation of all natural resources.

Objective 5

Importance of natural resources

Key terms:

- **Degradation**—Lowering quality of a resource
- **Depletion**—Using up the total quality of a resource

- a. Humans must have air, water, food, and shelter to survive.

Note: Sunlight is necessary for the production of food and the materials for many forms of shelter.

- b. Since many natural resources are unevenly distributed throughout the world, economics and politics play important roles in distributing these sometimes scarce commodities.
- c. A great threat to human survival is the **degradation** and **depletion** of natural resources.

Objective 6

Conflicts in natural resource management

Key term:

- **Environmental impact**—Changes in the environment caused by some form of management

- a. As populations increase, demands for natural resources increase.
- b. As natural resources are used, demands for their protection increase.
- c. Conflicts between use and preservation of natural resources are inevitable.
- d. Continuous adjustments and compromise between consumers and protectors of natural resources are necessary.

Note: There is no "pure" consumer nor "pure" protector of natural resources. Across the world, all people are consumers of natural resources. Some are producers of goods derived from renewable and nonrenewable natural resources; others are mainly consumers of these goods. Consumers who realize the need to conserve and wisely manage natural resources sometimes become "protectors," but they still remain consumers.

- e. Examples of conflict that have an **environmental impact** include:
 - Wetlands needed by wildlife are drained and used for crop production or urban development.
 - Agricultural land needed for food production is paved for urban development.

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Information Sheet

- Publicly owned forests needed for recreation are harvested for timber.
- Publicly owned forests needed for lumber (and the jobs involved in the timber industry) are placed off limits for harvest by recreation and preservation interests.
- Hunting is resisted by animal rights activists.
- Many development and agricultural activities destroy wildlife habitat.
- Swamps supporting a diversity of plants and animals are drained for urban and suburban development.
- Recreational uses of rural land can disrupt wildlife, and damage vegetation landscapes.
- Fossil fuel-fired electrical generation plants pollute the air of people who use electricity.
- Nuclear-powered electrical generation plants maintain clean air, but produce highly toxic waste products which must be stored and protected.
- Agricultural chemicals aid in producing abundant food supplies, but adversely affect surface and ground water.
- Vehicles needed to transport people to their work places increase air pollution.

Objective 7

Factors which affect natural resources

a. Natural occurrences

Examples: Droughts, floods, earthquakes, and volcanic eruptions

b. Air, water, and land **pollution**

Key term:

- **Pollution**—A reduction in the quality of the environment by the introduction of impurities

Figure 3



Air Pollution



Water Pollution



Land Pollution

Examples:

- Air pollution from industrial emissions, automobile exhaust, dust, and smoke
- Water pollution from domestic and municipal sewage entering waterways before proper treatment; industrial waste improperly disposed of in landfills that moves into ground or surface water
- Land (soil) pollution from pesticides, toxic waste, acid rain, and solid waste on the land

c. **Urbanization**

Key term:

- **Urbanization**—Growth or expansion of cities

Example: Elimination of natural wildlife habitats

d. **Agricultural practices**

Examples: Improper use of pesticides, soil erosion, and clearing forest or wetlands for crop production

e. **Mining practices**

Example: Strip mining that clears all surface vegetation during mining process

Information Sheet

	f. Drilling practices that may result in contamination of resources Example: Naturally occurring salt water getting into fresh water formations as a result of drilling
Objective 8	Preservation and conservation of natural resources a. Preservation—Provides for the use and enjoyment of certain areas while leaving them unaltered for future generations b. Conservation—Promotes the use of natural resources in a manner which minimizes waste, encourages renewal, and maintains that resource for future use
Objective 9	Preservation activities Note: Although to many, preservation is the maintenance of a geographic area without human intervention or access, in this study preservation includes conservation activities also. For instance, many "preservationists" are adamantly opposed to all hunting activities by humans and seek to stop the practice in the name of preserving wildlife. However, without wise management of wildlife populations, wild fluctuations of wildlife populations would occur as a result of disease and starvation and unchecked birthrates. So, the management of wildlife populations through legally described hunting practices, relocation, and habitat improvement are vital to maintaining or "preserving" a viable number of wildlife — a valuable natural resource. Key terms: • Ecosystem—A unit of the environment comprising the interaction of all organisms and the physical components within a given geographic area. • Endangered species—A species in immediate danger of becoming extinct • Protected species—A species whose life, habits, and habitat are protected by law a. Protect native animals and plants. Example: Protected species laws b. Protect migration routes and preserve suitable areas for migratory animals. c. Manage harvested species (game animals) through the use of fishing and hunting regulations. d. Identify and protect endangered species and the ecosystems on which they depend. e. Protect natural landscapes. f. Restore and replant land areas altered by human activity. g. Prevent wetland drainage for domestic or industrial use.

Objective 10

- h. Manage fires either by extinguishing or by allowing them to burn themselves out if they benefit the ecological plan of the area.
- i. Manage surface and ground water by controlling erosion and prevention.
- j. Manage air quality to protect human health, vegetation, visibility, wildlife, and fish.
- k. Manage soils to prevent soil erosion, physical removal, or contamination by waste disposal.

Conservation activities

Key term:

- **Ozone (O₃) layer**—Layer of the atmosphere that protects the earth from ultraviolet radiation in sunlight

a. Air conservation activities

- Since cars are major air polluters, keep your car tuned up, change fuel filters often, maintain emission control devices, and use unleaded gasoline.
- Drive less, ride more. Use mass-transit, carpools, bicycles, or walk to work.

Note: The less you use your car, the less pollutants you put into the environment.

- Avoid using toxic chemicals released into the air such as oven cleaners and window cleaners. Instead use water and soap, baking soda, or vinegar.
- Protect the environment from chlorofluorocarbons (CFCs) which are thought to deplete the **ozone layer**. Check your automobile for air-conditioning leaks, which can release CFCs.
- Plant trees. These use carbon dioxide and produce oxygen. Trees also help to purify the air, moderate temperatures, and absorb noise.

b. Water conservation activities

- Use low-flow shower heads. Short showers also use less water than baths.
- Use faucet aerators for each sink.
- Run washing machines and dishwashers only when they are full.
- Do not let faucets run while hand-washing dishes, brushing teeth, or shaving.

Information Sheet

- Water plants and lawns only as needed, and only in the morning to reduce evaporation.
- Use fertilizers and pesticides conservatively to prevent groundwater contamination.
- Fix leaky faucets or toilets.

c. Soil (land) conservation activities

- Keep soil covered with grass, ground covers, trees, and plants to prevent erosion.
- Use recommended conservation practices such as crop rotation, residue management, contouring, and terracing to protect the soil's fertility and to prevent erosion.
- Do not send toxic substances such as oil, pesticides, or batteries to the municipal landfill.

Note: Call your fire department about disposing of toxic waste.

d. Energy conservation activities

- Seal leaks and cracks around doors and windows with caulking and weather stripping.
- Increase the insulation in your home to the maximum recommendation.
- Drive fuel-efficient vehicles.
- Use mass-transit, carpools, bicycles, or walk.

Note: This cuts down on the fuel used as well as decreases air pollutants.

- Set hot water heater at 120°F instead of 140°F.
- Use a cooler wash and cooler rinse in washing machines.
- Turn down the heater at night.
- Use fluorescent lights instead of incandescent.

Note: Fluorescents use only one-fourth of the energy.

- Turn lights and TV off when not using them.
- Check for leaks around the refrigerator door. Also check the temperature. Set at 38°–42°F.

Objective 11

- Use high-efficiency appliances and those with energy-saving techniques.
- Use microwave ovens and pressure cookers because they use less energy, and save time too.
- Use alternative energies (solar, wind) where possible to lessen demand on nonrenewable resources. (fossil fuels).

Example: Dry laundry on a clothesline instead of in a dryer.

- Use products that are recycled, recyclable, repairable, refillable, reusable, and long-lasting.

Note: In the case of aluminum cans, it takes only five percent of the energy required to make a new can to recycle a used can and put it back on the shelf again.

Categories of solid waste

Key terms:

- **Waste**—Useless, unwanted, or discarded material
- **Hazardous (toxic) waste**—Waste material that poses a threat to human health.

Note: Many times waste products are quite valuable once a use or market for them has been found. For example, millions of cubic feet of natural gas are flared each day in the Middle East oil fields, because there is no ready pipeline to transport the clean-burning fuel to distant populated areas.

- a. Agricultural—Solid **waste** from raising, slaughtering, and processing animal products and from orchards and field crops
- b. Commercial—Waste from stores, offices, and other activities that do not actually turn out a product
- c. Industrial—Waste from industrial processes and manufacturing.
- d. Institutional—Waste from education, health care, and research facilities
- e. Pesticide—Residue from the manufacturing, handling, and use of chemicals designed to kill plants and animal pests
- f. Residential—Waste that usually originates in homes

Note: **Hazardous waste** material that can pose a serious threat to human health may originate at several of these sources. It must be separated from non-hazardous waste and be handled very carefully because it is toxic.

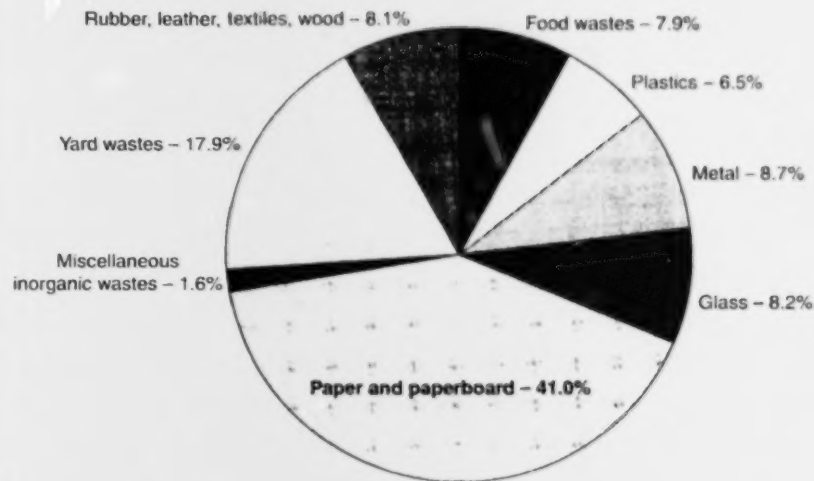
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Information Sheet

Objective 12

Composition of solid waste in a typical municipal landfill

Figure 4



Objective 13

Methods of waste disposal

a. Landfills

- Trash is dumped, and earth-moving equipment covers area with soil.
- Currently 80% of trash goes to landfills.
- Landfills are reaching capacity in many locations.
- Fewer landfills are being built because land is not available (in highly populated areas), land is suitable (too close to underground water or wetlands), or community groups oppose the landfill sites (the NIMBY — Not in My Backyard — syndrome).
- Improperly sited and maintained landfills contaminate the groundwater.
- Properly designed landfills include impermeable liners, leachate collection systems, and groundwater monitoring devices.
- Landfills will continue to be needed for wastes such as noncombustibles, nonrecyclables, and incinerator ash.

b. Incineration

- Combustible trash is burned which produces heat and energy that can be used. (Co-generation)
- About 10% of trash is incinerated (with or without energy recovery).

- Trash should be separated to only combustible trash.
- Faulty incinerators create air pollution and toxic ash by-products, especially if toxic materials are not separated out.
- Newer incinerators use advanced combustion systems, state-of-the-art air pollution controls, and restrictions on the kinds of waste that may be burned. These measures reduce air pollution significantly.
- The advantage of incinerators is that they reduce the volume of refuse by 90%.

c. **Recycling**

Key term:

- **Recycling**—Transforming waste products into new products
- This involves collecting, separating, processing, and marketing wastes such as glass, metals, and paper.
- About 10% of trash is recycled.
- Recycling can divert potentially large volumes of trash from landfills and incinerators, and can help conserve natural resources such as trees and oil.
- Materials that are recyclable must be separated before they can be recyclable.
- The challenge of making recycling economically feasible is to have a stable market for recycled products where supply equals demand.
- Technology for collecting and processing recyclables is improving.

Note: Plastics that used to be considered nonrecyclables are now being recycled.

Objective 14

Waste reduction activities

Key term:

- **Biodegradable**—A material that decomposes in the environment as a result of the activity of microorganisms

Note: Products vary in the amount of time they require to degrade, from a few weeks to thousands of years. However, many high **biodegradable** products buried in landfills, out of the sunlight and away from oxygen, lie for years without significant deterioration.

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a. Source reduction—eliminating waste before it happens

Note: This have been compared to preventive medicine which stops the problem before it becomes a problem.

- Minimize the volume and toxicity of products at the source—from designers and manufacturers.

Examples: Using less packaging and making products that can be recycled

- Make goods more durable so that longer periods of time elapse before they are discarded.

Examples: Radial tires that last 80,000 miles instead of 30,000; appliances that last 20 years or more.

- Consumers can encourage manufacturers to reduce waste by buying products that have less packaging, are free of toxins, are recycled or recyclable, and that are more durable.

b. Recycling—transforming waste into new products

Examples: Newspapers and greeting cards printed on recycled paper

c. Careful buying—knowing what to buy and what to avoid

- What to buy

- Products in concentrated forms
- Products in bulk
- Products made from recycled materials
- Products that can be recycled

Example: Plastic milk bottles instead of cartons that cannot be recycled

- Paper trash bags instead of plastic bags
- Cloth napkins and towels instead of paper
- Products that can be reused

Example: Ceramic mugs instead of polystyrene

- Rechargeable batteries
- Products that last longer

Example: Radial tires

Objective 15

- What to avoid

- Over-packaged products
- Throwaway items

Examples: Nonrefillable ball point pens

- Clothes requiring dry cleaning
- Disposable diapers
- Paper towels and napkins
- Colored paper products
- Excess food that will go to waste

Recyclables and nonrecyclables

a. Recyclables

- Materials

- Paper – Newspapers, corrugated boxes, and office paper
- Plastic – Milk and soft drink containers
- Glass – Bottles and jars
- Aluminum – Cans
- Steel – Appliances
- Scrap metal – Food cans
- Wood – Pallets and lumber
- Motor oils

- Compost

- Leaves, grass, and brush
- Food wastes – vegetables, not meat
- Some other organic materials, such as paper contaminated with food

Note: Experts estimate that as much as 50% of all U.S. solid wastes is recyclable.

b. Nonrecyclables

- Wastes heavily contaminated by food residues, household chemicals or dirt
- Composite materials

Examples: Boxes made of paper, foil, and adhesives, plastic-coated paper, furniture, and appliances (other than metal covered)

- Miscellaneous inorganics, such as street sweepings

Information Sheet

Objective 16

Federal agencies responsible for natural resources

- a. Department of the Interior
 - National Park Service – Manages more than 300 areas with the national parks system
 - Fish and Wildlife Service – Helps protect the nation's birds, mammals, fish, and other wildlife
 - Bureau of Land Management – Manages federal grasslands, prairie, desert, forest, and other open spaces of the nation's public lands
 - Bureau of Indian Affairs – Works to promote the welfare of the nation's Native Americans and their lands
 - U.S. Geologic Survey – Conducts surveys of the land and its resources and develops maps based on these surveys
 - Bureau of Mines – works to ensure efficient mining, processing, use, and recycling of mineral resources
 - Bureau of Reclamation – Works to develop water, land, energy resources, and other natural resources in the western United States
- b. Department of Agriculture (USDA)
 - Forest Service – Works to manage and protect forestland and grassland while promoting their best use
 - Natural Resources Conservation Service – Helps prevent soil erosion from wind and water by working with local soil and water conservation districts and assisting in individual conservation plans and other conservation measures
 - Agricultural Stabilization and Conservation Service – Administers programs with funding for agricultural conservation activities and administers farm programs
- c. Environmental Protection Agency (EPA) – Determines environmental standards and enforces federal environmental laws
- d. Department of Energy – Oversight of nuclear power research in several laboratories across the nation
- e. Department of Defense (DOD) – Responsible for environmental impact of nation's network of military bases.
- f. U.S. Army Corps of Engineers – Responsible, along with U.S. Fish and Wildlife Service, for environmental integrity of federal land and navigable public waterways

Information Sheet

Objective 17

Types of occupations in natural resources

Key term:

- **Ecologist**—One who studies the relationship between organisms and their environment

a. Occupations that manage natural resources

Examples: Biologists, wildlife managers, foresters, soil conservationists, **ecologist**

b. Occupations that collect and harvest natural resources

Examples: Miners, farmers, loggers, anglers, commercial fisheries

c. Occupations that make products from natural resources

Examples: Manufacturers, processors

d. Occupations that use products made from natural resources

Example: Consumers

e. Occupations that convert natural resources to energy

Examples: Power plants, fuel companies

f. Occupations that provide services

Examples: Salespeople, truckers, engineers, teachers, technicians

g. Occupations that enforce laws affecting natural resources

Examples: Rangers, agents, EPA officials

h. Occupations that dispose of waste

Examples: Solid waste managers, trash collectors, recycling center employees, environmental scientists

Objective 18

Getting a job in natural resources

- Identify government agencies and private industries that have jobs of interest to you.
- Become familiar with businesses and industries involved with natural resources
- Request information and brochures related to your interests.
- Get job-related experience as soon as possible.

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Information Sheet

Objective 19

- e. Determine education required for various jobs.
- f. Secure summer employment or volunteer work in a related area.
- g. Get to know local individuals working in natural resources.

Characteristics of a person working in natural resources

- a. Desires to work outdoors
- b. Desires to work in agriculture-related areas
- c. Has a concern for the environment
- d. Likes to interact with the natural environment
- e. Likes to work with people

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**Student Supplement 1—The Hows and Whys
of Compost****Soil**

Unless one is an active gardener or thoughtful farmer, soil is soil. Or, "dirt" as some people call it.

Soil is more than an anchor for plants, however, and must be just as alive and vital as a growing crop for proper plant growth. In addition to providing plants nutrients from soil minerals, soil also must be capable of holding adequate water to supply plants, and it must be porous enough to allow water and oxygen-bearing air to percolate from the surface to surround actively growing root tips. Also, it should contain millions of microorganisms (beneficial bacteria) per cubic inch which also help plant growth through their conversion of organic matter into useable plant nutrients.

Sufficient amounts of organic matter are absolutely necessary. Organic matter (material rich in carbon) can come from many sources. Dead and dying plant material, vegetable wastes, used hay or straw and manure from livestock bedding and feeding areas, shredded newspapers—anything that will decompose back to the soil in a reasonable amount of time can be a source of beneficial organic matter.

For years farmers concerned with their soil have known that returning manure and crop residues to the soil helps prevent crusting of soil surfaces after heavy rains, prevents erosion, and generally helps crop production.

The rich prairie soils of the U.S. Great Plains were built up as, year after year, native prairie grasses died in the winter and fell to the ground to decompose as a mulch for the next year's stand of grass. Once settlers began plowing the prairies, they exposed those thousands of year's worth of organic matter to oxygen, which unleashed a chemical reaction in the soil that left much nitrogen (one of the important nutrients for plant growth) available to feed crops. Today, farmers and gardeners interested in improving their soil's productivity spend much time managing crop residues and returning organic matter to their soils.

Compost

To speed up the process of supplying organic matter to crop producing soils, many gardeners and some large scale farms use the process of composting organic matter to produce the black, fragrant, crumbly, partially digested organic residue from crop and garden waste called compost.

On large-scale cattle feeding operations in the High Plains of Texas, Oklahoma, Kansas, Colorado, and parts of Nebraska, where huge feedlots finish hundreds of thousands of cattle each year, manure from the feeding process is arranged in long, deep rows and composted into a friable, easily handled material which is an extremely popular natural fertilizer for nearby farms.

Across the nation, gardeners by the thousands tend to compost heaps where they place their yard and garden wastes to decompose into valuable soil-building compost. Kitchen wastes, animal manures, weeds, grass clippings and leaves, and shredded branches, all contribute to the productivity of these gardeners' soils.

Student Supplement 1

There's nothing magic about making compost. It's a natural process that will occur anyway wherever organic matter decomposes. Composting just concentrates the process where a farmer or gardener can get the most benefit from the process.

To build a compost pile, use a mixture of green and dry materials. Green materials decompose rapidly; grass clippings, lettuce leaves, tomato and pea vines, and other succulent materials contain sugar and proteins that provide excellent nutrients for soil organisms. Dry materials, however, such as saw dust, small twigs and prunings and aged tomato vines etc., contain very little nitrogen and decompose rather slowly by themselves. By mixing green and dry material—along with animal manures or other materials rich in nitrogen, such as alfalfa hay—the pile will compost at a rapid rate. In fact, some expert gardeners can arrange their compost heaps in a manner which will turn shredded residues into useable compost in two to three weeks. For most, however, 6 to 12 weeks is required to produce the fluffy, black, naturally fresh-smelling product.

The size of the material being composted is important too. If dry leaves and other dry matter are put through a shredder (or chopped with a lawn mower) the small pieces will decompose much more rapidly because they have more surface area exposed to oxygen and decay organisms. Shredding also creates a fluffier mixture, allowing for more water and air penetration. If grass clippings are used, they should be mixed thoroughly into the pile to prevent them from matting and souring and attracting flies. (The putrefaction process comes from anaerobic (without oxygen) digestion. This process produces many compounds rich in ammonia and sulfur—which are unpleasant to the nose.)

To get the most from a compost heap, many have found alternating layers of green and dry material, along with layers of existing compost and animal manures provides an excellent base for the beginning of natural digestion. Wetting down the dry material as it is placed in the pile will help get the compost process started earlier and maintain it through several days of "digestion." Once the pile has been built to a height of three or four feet, a layer of soil or existing compost on top will serve as an insulator to hold naturally occurring heat within the pile. In a properly designed compost pile, the center of the pile will reach nearly 160°F for several days.

Once every three or four days the temperature of the pile should be checked with a thermometer. Once the inner temperatures begin to fall to only warm levels, the pile should be turned with a shovel or pitch fork to expose new material to microorganisms and oxygen. This will cause a repeat of the heating process, although the high temperatures will not last as long as the "Fuel" of the pile is being consumed with each process. Once no more heating is observed, the compost should be ready to apply as a mulch or stored for later use.

A good way to manage this process is to build an area for three piles: one to accumulate kitchen and yard and garden waste; one to house the actively "working" pile and; one to store completed compost.

Student Supplement 1

Tips for Composting

1. Compost piles of about a cubic yard (or meter) are easily managed and quite productive.
2. Shred material finely for quicker processing.
3. To improve quality of compost, add earth worms to it after it cools. Worms further digest the organic matter and actually add significant amounts of nitrogen to it in the process.

Troubleshooting a Compost Pile

The pile doesn't heat up:

1. The pile may be too small. Rebuild it and make it larger.
2. The pile may be too dry. Rebuild it, watering each layer thoroughly as you rebuild. This is especially important when layering dry materials.
3. The pile may contain too much dried material (and too little nitrogen). Turn it and add some high-nitrogen fertilizer, animal manures, or leafy green organic matter.

The pile produces objectionable smells:

1. If it smells like ammonia, it has too much high nitrogen matter. Layer in some straw, leaves, or sawdust.
2. If it smells like rotten eggs, it is too wet (not enough oxygen), turn it and layer in some dry matter.

The pile attracts pests:

1. If rodents and/or dogs are attracted to the pile, it may contain meat scraps or exposed manure. Remove the material or bury it deep in the pile.
2. If insects are a problem, the pile is not heating properly. Insects cannot tolerate the heat of a properly operating compost pile. Also, once the heat has cooled, the material in the pile is decomposed sufficiently so as not to interest insects.

Student Supplement 1

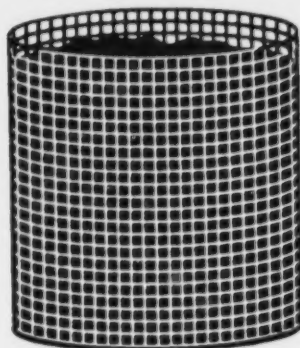
Structure

Structures for composting can be quite simple and inexpensive, but they must allow for easy handling of the material and flexibility in moving the material through its natural process.

The accompanying illustrations give ideas on simple to more complex composting structures.

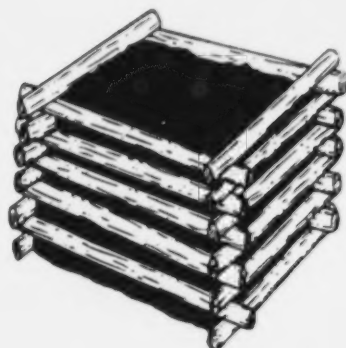
- a. A simple bin can be made from a cylinder of wire fencing, livestock panel, or reinforcing mesh.

Figure 1



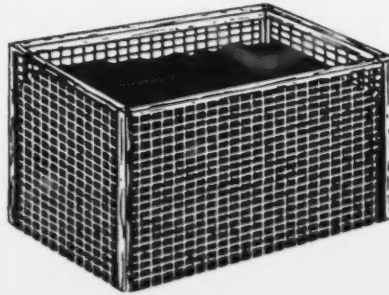
- b. This bin, built "log cabin" style from landscape timbers or other posts, can be built without fasteners as it is filled. Its removable sides allow for easy access and oxygen and water penetration.

Figure 2



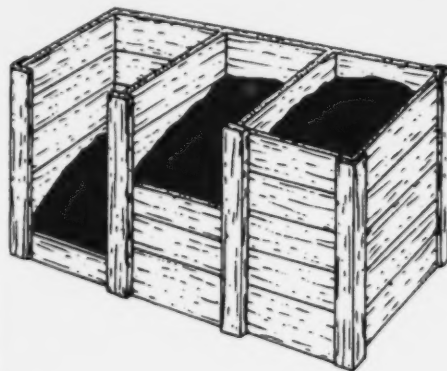
- c. This bin is made by driving corner posts in the ground and wrapping with screen mesh. This design allows sufficient support for a cover to prevent damage from heavy rains or animals.

Figure 3



- d. This more elaborate compost bin features removable front boards for easy access in loading, unloading, and stirring compost. Or, one bin can be used for accumulation of compostable material, one can be used for the active pile, and the other used for storage. Some producers alternate bins as they "turn" the "active" pile to an adjacent bin, and build a new pile in the bin most recently emptied.

Figure 4



Additional information on composting and compost structures is available at your state's land-grant university's Cooperative Extension office, most public libraries, and many gardening books and magazines available at bookstores.

Unit 3

Water Resource Management

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* Assignment Sheets are located in the Student Workbook.

Objective Sheet

Unit
Objective

After completing this unit, the student should be able to discuss the ground water/surface water relationship and the physical/chemical considerations necessary to manage this vital natural resource. The student should demonstrate these competencies by completing the assignment sheets and by scoring a minimum of 85 percent on the written test.

Specific
Objectives

After completing this unit, the student should be able to:

1. Match terms related to water resource management with their definitions.
2. Select true statements concerning the history of the importance of water in the United States.
3. Complete statements concerning water distribution.
4. List uses of water.
5. Complete statements concerning the hydrologic (water) cycle.
6. Complete statements concerning surface water.
7. Select true statements concerning ground water.
8. Describe the relationship between ground water and surface water.
9. Select true statements concerning water pollution.
10. Compare the state of the environment of 1960 and now.
11. Select true statements concerning hazardous/toxic waste.
12. Match the roles of government agencies and policies to ensure environmental protection of water resources with their intended purposes.
13. Select true statements concerning watersheds.
14. Match water measurement terms with their definitions or equivalents.
15. List career opportunities in water resource management.
16. Evaluate your source of drinking water. (Assignment Sheet 1)
17. Survey your area to identify water pollution sources. (Assignment Sheet 2)

Objective Sheet

18. Determine ways to reduce home water consumption.
(Assignment Sheet 3)
19. Calculate the cost of water. (Assignment Sheet 4)
20. Calculate and draw conclusions from water measurements.
(Assignment Sheet 5)
21. Analyze current reports concerning water resource management.
(Assignment Sheet 6)

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Information Sheet

Introduction

Water is the only substance necessary in all life forms. Many organisms can live without oxygen, but none without water.

In the United States, 330 billion gallons of water are withdrawn from freshwater sources everyday. American households consume 26 billion gallons of water. The other 304 billion gallons are used for industrial or agricultural purposes and returned to streams, rivers or ground water sources. The average domestic use of water by Americans is 90 gallons per person per day.

The quality of the 90 gallons of water we consume each day should be of the utmost importance. This water is used for drinking, food preparation, washing, and cleaning. We do not want to clean with or drink dirty or contaminated water. A large majority of the 90 gallons used is returned as wastewater and is required to go through a treatment process in order to be returned to the environment.

Since water is a consumable resource, we each have a responsibility to do our part in water management and reducing contaminants from entering our freshwater sources.

How does the quality of water effect your life? How much would you pay for a glass of water? The answer to these questions depend on supply and demand for water. The demand for clean, fresh water is becoming an issue in our society. The availability of clean, fresh water in the future is yet to be determined. The cost associated with keeping the quality in water increases every year, because freshwater sources are becoming polluted and contaminated. Therefore, the demand for water continues to increase. In this unit we will attempt to answer the questions: What are the economic factors associated with water quality? What is in the future involving water quality?

Objective 1

Terms and definitions

Aquifer	Hydrologic cycle
Ground water	Septic system
Ground water recharge	Surface water
Hazardous (toxic) waste	Water pollution
Hazardous waste site	Watershed
Heavy metals	Water vapor

Objective 2

History of the importance of water in the United States

- As the United States was settled, the availability of water was of prime concern because water is critical to the survival of all organisms.
- Major population centers were located on rivers and lakes.
- Water wheels were used to harness water's power.

Examples: Grinding corn and wheat and generating electricity

Information Sheet

Objective 3

- d. Waterways were used for transportation.
- e. New industries that formed required large quantities of water.
- f. Clean water has always been required for human consumption, agriculture, and fish and wildlife.
- g. Water has been used extensively as an economic and recreational resource.
- h. Historically, water has always been a vital natural resource.

Water distribution

- a. Water covers about 71% percent of the earth's surface.
- b. 97% of surface water is salt water contained in the oceans.
- c. 2% of surface water is contained in polar ice caps and glaciers.
- d. 1% of the earth's fresh water is available for human consumption.
- e. 97% of fresh water in the United States is contained underground in aquifers.
- f. 3% of fresh water in the United States exists in streams and lakes.
- g. The volume of ground water in the U.S. that is economically recoverable is equal to 9 times the volume of the Great Lakes.

Objective 4

Uses of water

- a. Domestic (cooking, drinking, and sanitation in homes)
- b. Agricultural (livestock and crop irrigation)
- c. Industrial
- d. Business
- e. Fish and wildlife habitats
- f. Recreation

Objective 5

Hydrologic (water) cycle

Key terms:

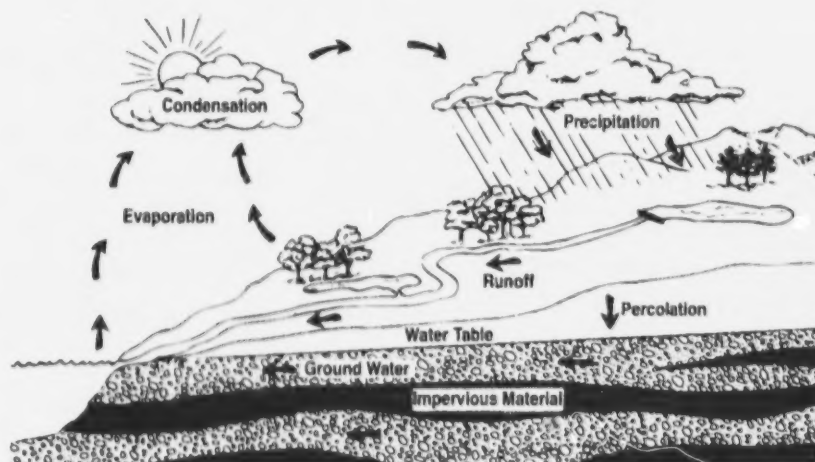
- **Hydrologic cycle**—Continuous circulation of water between the oceans, atmosphere, and the earth's surface.
 - **Water vapor**—Water which has evaporated and is suspended in the air.
- a. Water exists in various forms.
 - Liquid—In streams, lakes, rain, and ground water aquifers
 - Solid—In polar ice caps, glaciers, snow, hail, sleet, and frozen lakes
 - Vapor—Water which has evaporated and is suspended in the atmosphere
 - b. The total volume of water on earth remains constant.
 - c. Water continuously moving between the oceans, atmosphere, and surface water bodies constitutes the **hydrologic cycle**.
 - Water from surface water bodies and plants changes from liquid to **water vapor** (*evaporation*).
 - Water vapor changes to liquid as it is cooled in the atmosphere (*condensation*).
 - Condensed water falls to the earth as rain or ice (*precipitation*).
 - Water forms streams and rivers on the earth's surface (*runoff*), or water infiltrates the soil (*percolation*), supplying moisture for root systems and recharging ground water aquifers.

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Information Sheet

- d. The hydrologic cycle is responsible for restoring water supplies which are lost to evaporation, runoff, and human use.

Figure 1



Objective 6

Surface water

Key term:

- **Surface water**—Water visible on the earth's surface.
Examples: Streams, farm ponds, lakes, rivers, oceans, wetlands, swamps, and estuaries
- a. **Surface water** is used extensively without treatment.
- b. Surface water must be treated before it can be used for domestic consumption and industrial processes.
- c. Drinking water supplied to half of all Americans comes from surface water.

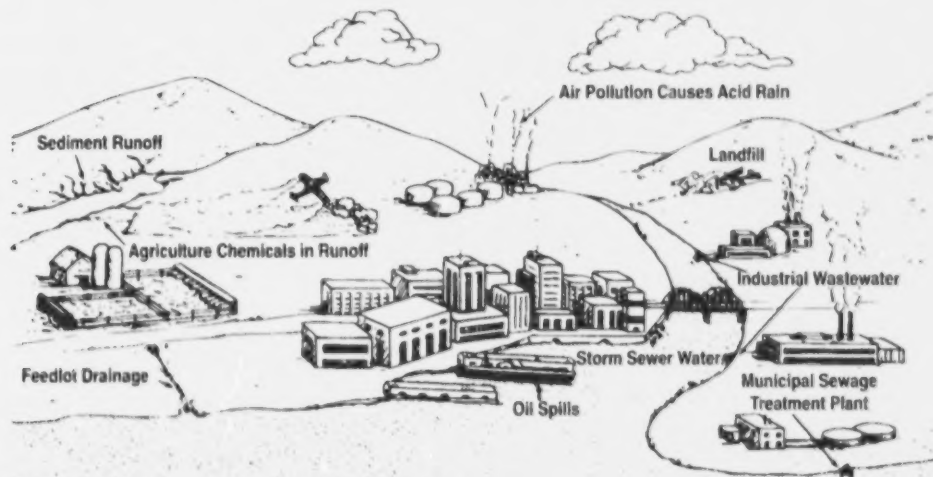
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Information Sheet

- d. Surface waters are easily contaminated by human activities.

Examples:

Figure 2



- e. Since quantities of surface waters are limited, their use must be conserved.

Objective 7

Ground water

Key terms:

- **Aquifer**—Sand, gravel, or rock formation found below the earth's surface which is saturated with water.
- **Ground water**—Water which is found below the earth's surface.
- **Ground water recharge**—Water which seeps through the earth's surface and into ground water aquifers.
- **Septic system**—A waste treatment system used primarily in rural areas or where city sewer lines do not exist.

- a. Ground water **aquifers** are sand, gravel, and rock formations below the earth's surface which are saturated with water.

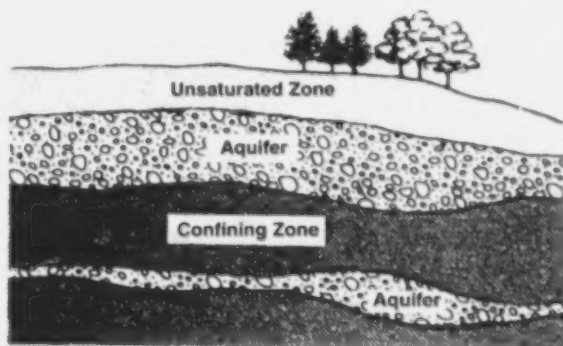
- Aquifers are located a few feet to several hundred feet below the earth's surface.

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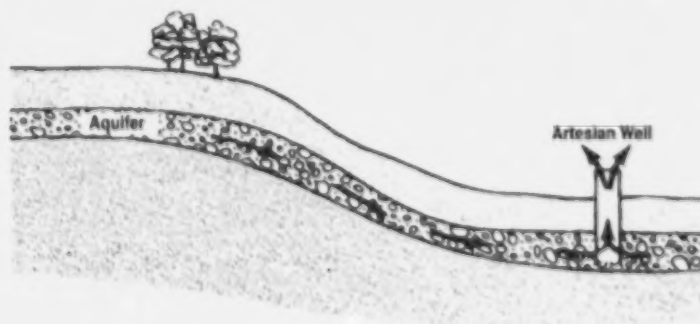
- Aquifers vary in thickness from a few feet to several hundred feet.

Figure 3



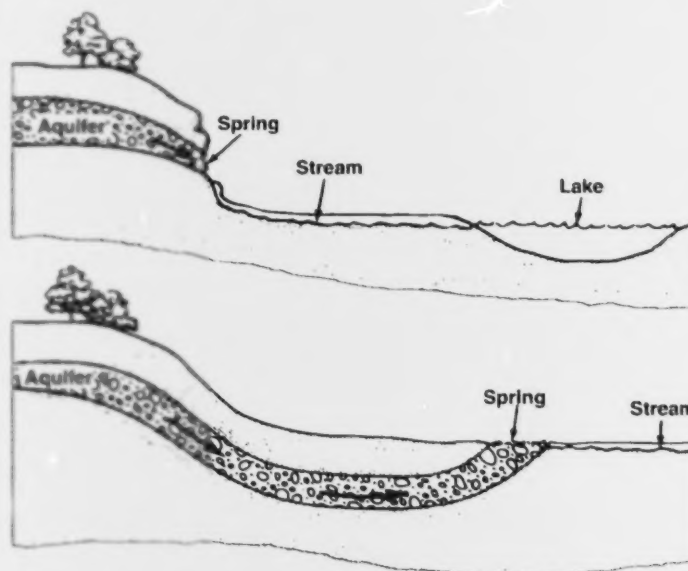
- b. Wells are drilled into aquifers to bring water to the surface where it can be used.
- c. Half of all Americans and 95 percent of rural Americans use **ground water** for drinking water.
- d. Contrary to common belief, ground water does not exist as rivers and lakes beneath the earth's surface.
- e. The area between the earth's surface and the top of the aquifer is the unsaturated zone.
 - The unsaturated zone is composed of various soil types.
 - The unsaturated zone contains moisture but is not saturated.
 - The **ground water** aquifers are **recharged** (replenished) by surface water penetrating the unsaturated zone.
- f. Artesian wells are created when aquifer elevations are higher than the top of the well drilled into the aquifer.

Figure 4



- g. Springs exist where aquifer elevations are higher than the spring outlet.

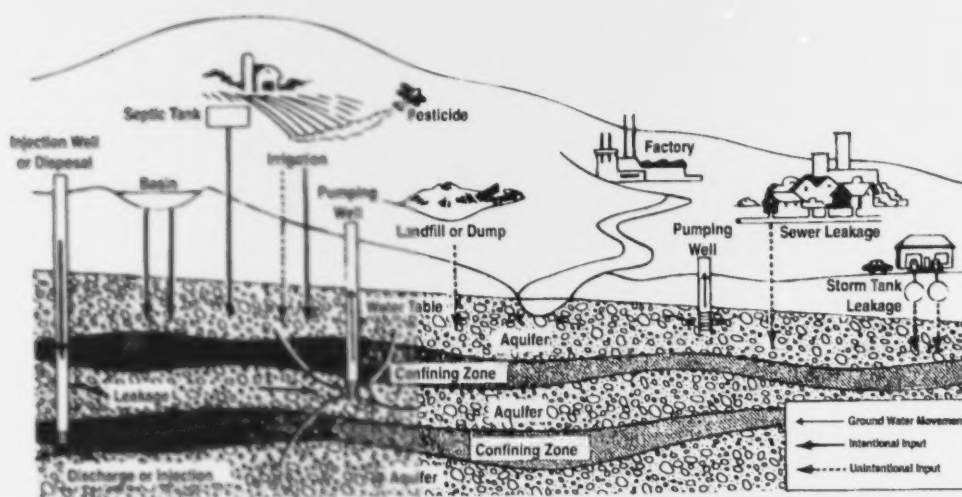
Figure 5



- h. Ground water contained in aquifers generally moves very slowly from a few inches to a few feet per day.
- i. Ground water can be easily contaminated by human activities.

Examples: **Septic systems**, pesticides and chemicals, factory wastes

Figure 6



Courtesy of U.S. Environmental Protection Agency

Information Sheet

Objective 8

- j. Ground water supplies are limited.
 - Ground water use must be regulated and conserved.
 - Ground water resources must be protected from contamination.

Relationship between ground water and surface water

- a. Ground water and surface water are intimately related.
- b. Changes in surface water quality or quantity can affect ground water quality and quantity.
- c. Changes in ground water quality or quantity can affect surface water.
- d. Ground water supplies the base flow for all streams and rivers.
- e. During periods of high river and stream elevations, surface water can enter ground

Objective 9

Water pollution

Key terms:

- **Heavy metals**—Metallic elements with high molecular weights; generally toxic to plant and animal life.
Examples: Arsenic, cadmium, chromium, lead, mercury
- **Water pollution**—Water which is made chemically, biologically, or physically impure or unfit for use.

- a. Historically, **water pollution** has caused serious epidemics and health problems in the United States.

Examples: Cholera, typhoid, infectious hepatitis, **heavy metal** poisoning, dysentery

- b. Many municipal water supplies using surface water were often contaminated.
- c. Rural water wells were often contaminated by livestock and human waste.
- d. Most epidemic sources of biological pollution were identified and eliminated in the mid-1900's.
- e. As biological epidemics decreased, instances of chemical pollution of water resources increased.
- f. Chemical pollutants are created as by-products of manufacturing, waste from industrial processes, agricultural and lawn chemicals and fertilizers, and domestic waste disposal practices.

Objective 10

g. Pollutant origin can be generally divided into two categories:

- Point source—Pollution which can be traced to a point of discharge such as a drain pipe from an industry or sewage treatment plant.
- Nonpoint source—Pollution which enters the environment from a wide area such as soil erosion from construction sites, pesticides, fertilizers, and animal waste from agricultural practices, and drainage from mining practices.

Comparison of the environment—1960 and now

a. State of the environment—1960

- Surface waters and ground waters were severely polluted.
- Pollution of water in the Great Lakes had reduced or eliminated major fish species.
 - Untreated sewage from large population centers entered the lakes.
 - Industrial waste was released directly into the lakes or tributaries.
- Coastal waters were placed off-limits to fishing.
 - Pollutants from industry, refineries, and agriculture had contaminated the waters and bottom sediment in many areas.
 - Municipal waste from sewage treatment plants in many areas contaminated viruses and bacteria which entered the food chain.
 - Fish and shellfish were unfit for human consumption in many areas
- Streams and major rivers were polluted by raw sewage and untreated industrial waste.
- Sediments entering streams increased turbidity and covered spawning beds with silt, critically reducing fish numbers and species.
 - Lumber companies removed forests next to streams promoting erosion.
 - Mining companies removed surface vegetation and abandoned surface mines creating erosion avenues.
 - Construction of roads, businesses, and residential areas created areas of soil instability.

Information Sheet

- Wetlands, which provide a diverse and prolific ecosystem, were destroyed.
 - More than 50% of the wetlands in the U.S. had been converted to other uses. Wetlands were drained and converted to agricultural, industrial, or residential areas.
 - The rate of wetland loss was 500,000 acres annually.
- Ground water pollution had been detected in every state. Contamination sources included:
 - Nitrates and pesticides from agricultural areas
 - Septic systems
 - Contaminated surface impoundments
 - Leaking underground and surface storage tanks
 - Hazardous waste disposal sites
- b. State of the environment—Now
 - The Environmental Protection Agency, along with other federal, state, and local environmental agencies, environmental groups, and concerned citizens, have made significant progress in restoring water quality.
 - Waste discharges from industry are regulated and enforced.
 - Municipal sewage treatment plants no longer release untreated waste to the environment.
 - Dumping of waste in the ocean is regulated.
 - Pesticides are now classified and their use is regulated.
 - Safe limits on chemicals in drinking water have been set.
 - Transport of hazardous chemicals is regulated.
 - Storage and disposal of hazardous waste is regulated.
 - Funds have been provided for the cleanup of existing hazardous waste sites.
 - Sediment from mining operations and lumber mills are monitored and controlled.
 - Wetland loss has been reduced to less than one tenth of its 1960 annual rate through better protection.
 - Ground water resources are now better protected from sources of pollution.

Objective 11

Hazardous/toxic waste

Key terms:

- **Hazardous (toxic) waste**—Waste that poses a serious threat to human health even at extremely low concentrations.
 - **Hazardous waste site**—A location where hazardous waste poses a potential threat to the environment.
- a. Improper **hazardous waste** disposal is a serious threat to water resources.
 - b. Hazardous waste is generated by:
 - Petroleum and petrochemical plants
 - Fertilizer producers
 - Metal refineries
 - Electroplating industries
 - Mining industries
 - Plastics manufacturers
 - Pharmaceutical companies
 - Nuclear weapons systems and power plants
 - c. Until 1975, open dumps were used to dispose of most hazardous waste.
 - d. The main objective of the Resource Conservation and Recovery Act of 1976 was to regulate the disposal of hazardous waste.
 - e. Potential sources of water resource contamination include:
 - **Hazardous waste sites**
 - Surface pits used for waste disposal
 - Hazardous waste land disposal facilities
 - Municipal landfills
 - Underground storage tanks (hundreds of thousands are estimated to be leaking.)
 - Agricultural pesticides and fertilizers
 - f. Major environmental concerns are for man-made chemicals found in plastics, solvents, pesticides, paints, dyes, varnishes, and ink.

Information Sheet

Objective 12

- g. Health problems associated with hazardous waste contamination include cancer, brain and nerve damage, birth defects, and miscarriages.

Note: One of the greatest concerns about toxic chemicals is that they stay in the body for extended periods.

Roles of government agencies and policies to ensure environmental protection of water resources

Note: Though approaches differ, the long-term welfare of the people in a nation depends on a government that is sensitive to environmental issues. Federal, state and local agencies and policies assume these government roles.

- a. Development—Recognize the role of sustainable economic development.
- b. Rules and regulations—Promote or stifle environmental concerns.

Examples:

- Transportation systems will be developed to lessen dependence on automobiles, particularly in large cities.
- More wastes will be disposed of properly, with many being recycled.
- Environmentally damaging manufacturing and agriculture is under scrutiny.

- c. Quality assurance—Assure safe supplies of food, water, and air.
- d. Environment damage—Assure that past environmental damage is cleaned up.

Examples:

- Dump sites and polluted areas will be restored.
- Individual responsible for environment damage will be held accountable.
- The Federal government will continue its superfund to help finance cleanup efforts.

Information Sheet

Selected Federal Legislation for Environmental Protection of Water Resources		
1889	Refuse Act	First governmental action involving water pollution. Banned the discharge of all foreign materials, except liquid sewage, from entering navigable water.
1970	National Environmental Policy Act	Requires environmental impact statements for all projects affecting the environment
1972	Clean Water Act (Amendment to 1948 Federal Pollution Control Act)	Regulates discharges from industry and sewage treatment plants
1972	Marine Protection Research and Sanctuaries Act	Regulates ocean dumping
1972	Insecticide, Fungicide, and Rodenticide Act	Classifies pesticides and regulates their use
1974	Hazardous Materials Transportation Act	Regulates transportation of hazardous materials
1976	Resource Conservation and Recovery Act	Regulates the treatment, storage, and disposal of hazardous waste
1976	Toxic Substances Control Act	Regulates use of dangerous chemical substances
1980	Comprehensive Response Liability Act ("Superfund")	Provides funds for cleanup of toxic waste dump sites that endanger the public
1987	Water Quality Act	Continues support for sewage treatment plants, initiates new programs to control nonpoint pollution sources, and imposes tighter control on toxic pollutants

Note: Various state and local environmental agencies have passed additional legislation to control specific environmental problems in their area.

Objective 13

Watersheds

Key term:

- **Watershed**—Total drainage areas where water flows to a common point such as a river or lake.

Note: Watersheds are often called basins or drainage areas.

a. Watersheds vary in size.

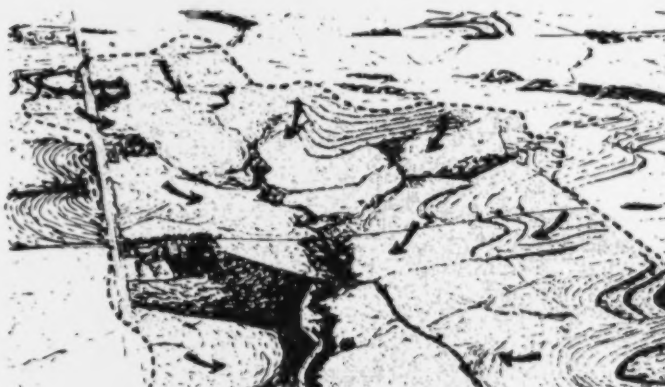
- Small watersheds may drain only a few acres before the water is contained in a farm pond or lake.

Information Sheet

- Large watersheds may cover millions of acres and drain water from several states.

Example: Watershed

Figure 7



- b. Water collected in watersheds is carried away by streams or rivers or is collected behind dams for various uses.
- c. Rainwater or water collected in watersheds may also seep into aquifers.
- d. Land areas where surface water enters aquifers are called ground water recharge areas.
- e. Water pollution is generally caused by human activities on land within the watershed.

Examples: Industrial waste; agricultural chemicals (pesticides, fertilizers); sediment from construction, farmlands, and mining activities; acid rain from fossil fuel combustion; solid waste disposal sites; and municipal sewage treatment plants

Objective 14

Water measurements

Note: It is necessary to use abbreviations and conversion factors when determining water volume, water flow, and water quality.

- a. Water volume is measured in:
 - Milliliter (ml) = 1/1000 of a liter
 - Liter (l) = 1000 ml
 - Gallon (gal) = 3.785 liters
 - Cubic feet (cu.ft.) = 7.48 gal
 - Acre foot (for lake water volumes)—1 acre of water, 1 foot deep = 326,000 gallons

Objective 15

b. Water flow is measured in:

- Gallons per minute (GPM)—This is usually how water well flow is measured.
- Cubic feet per second (cu.ft./sec)—This is usually how stream and river flow is measured.

c. Water quality is measured in:

- Parts per million (PPM)—1 part contaminant per 1 million parts water
- Milligram per liter (mg/l) = 1/1000 of a gram in 1 liter of water

Note: Milligram per liter and parts per million are equal. Parts per million is more commonly used.

- Parts per billion (PPB)—1 part contaminant per 1 billion parts water

Career opportunities in water resource management

- a. Hydrologist
- b. Chemist
- c. Geohydrologist
- d. Soil scientist
- e. Environmental scientist
- f. Biologist
- g. Chemical engineer
- h. Sanitary engineer
- i. Agricultural engineer
- j. Chemical, physical, and biological technician

Note: Salaries of individual careers are dependent upon level of education and experience.

Student Supplement 1—Water Facts

1. Seventy-one percent of the earth's surface is covered with water.
2. The body of an adult human is made up of 65 percent to 70 percent water.
3. A human can survive only five to seven days without water.
4. A leaking faucet can waste up to 100 gallons of water per day.
5. Evenly distributed, the earth's annual rainfall could cover every square foot of land to a depth of about three feet.
6. In one summer day a single willow tree can use and lose more than 5,000 gallons of water.
7. An acre of corn produces more atmospheric water vapor than a lake of the same size.
8. Three quarters (75 percent) of the weight of a living tree is water.
9. The average American uses the following amounts of water:
 - 40 gallons for one load of clothes in a washing machine
 - 5 gallons of water per flush of the toilet x 6 flushes a day for a total of 30 gallons
 - 30 gallons for a shower
 - 4,000 gallons of water for a 1-inch irrigation of an average lawn
 - 2 gallons of water to brush teeth (if the water is allowed to run throughout the process)
 - 20 gallons of water to run a load of dishes in an automatic dishwasher
 - 168 gallons of water total household use per person per day
10. A ten-minute shower without a flow restrictor consumes about 55 gallons of water.
11. A typical bath can consume 25 to 50 gallons of water.

**Student Supplement 2—Water Conservation Methods
for Household Activities**

Significant amounts of water can be saved by individuals without drastically altering their habits or comfort levels.

Considering the typical shower can consume up to 55 gallons of fresh water in ten minutes, the addition of an inexpensive flow restrictor can reduce that amount to 20-30 gallons. Of course reducing the time spent in the shower directly affects the amount of water consumed, so shorter, more efficient showers can add up to many gallons of water saved.

Baths, too, can waste water, especially if the tub is filled to the maximum.

Many automatic washing machines consume up to 40 gallons of water per washing cycle. Newer machines are designed to operate with less water, but unless you are purchasing a new washing machine these efficiencies are not a practical solution. Washing only full loads will get the most of the water your washer requires. This requires planning and a little sorting management, but the water saved can be significant.

Dishwashers, too, consume a given amount of water, usually around 20 gallons, for each cycle. Again, washing only full loads will get the most for your water consumption. If you are purchasing a new dishwasher, be certain to shop for the most energy and water efficient models you can afford.

Car washing can consume large amounts of water, especially if a garden hose is used without a hose-end nozzle that is capable of being turned off. A good method to use to save at-home car washing water is to rinse the vehicle thoroughly, then turn off the water. Using a bucket of soapy water and a sponge or wash cloth, clean sections of the car thoroughly and rinse each as you finish. Once the entire vehicle has been cleaned, rinse it again thoroughly and turn the water off. Using a clean bucket of water, soak a chamois skin and wring it out before drying the vehicles glass and sheet metal.

Another waste of water comes in cooking and brushing teeth, as a faucet is left running when only a small amount of rinse water is actually needed. In some cases a person brushing teeth can consume up to 2 gallons of water when only a few ounces actually are needed to rinse the brush and mouth. Running a faucet while peeling potatoes or other vegetables is another wasteful habit. A pan of water works quite well to rinse vegetables and catch peelings, and it saves many gallons of water that otherwise would run down the drain, unused.

Student Supplement 2

Lawn and garden watering can consume many thousands of gallons of water needlessly. True, landscape and lawns need water and when dry weather is parching the soil they must be irrigated adequately to prevent their deaths. But, most homeowners water too much, or provide wasteful inadequate waterings which consume water but don't help the plants. Some tips for getting the most of your landscape watering include:

- Water at night when wind and evaporation rates are lower.
- Use trickle irrigation or "weep" hoses in permanent flower beds and vegetable gardens. The water efficiency is much higher with these more precise water application tools.
- In extremely dry weather, let the lawn take care of itself...especially in southern climates where bermudagrass is the lawn of choice. It may look brown and dead, but with the first rain it will "green up" almost immediately.
- Plant ornamentals that require less water than others. So-called Xerographic landscaping takes advantage of cactus and other low water requirement plants to provide outdoor beauty and efficient water use in the landscape.

Another source of water waste is in inefficient plumbing fixtures, particularly those with dripping leaks. A dripping faucet can waste anywhere from 10 to 100 gallons a day depending upon its severity. Usually these leaks can be repaired with a washer that costs less than \$1 at local department stores. Leaking toilets, those which run continually or periodically run to fill the flush tank, are major wasters of fresh water. If you can't repair them yourself, ask a friend or a plumber to make the necessary adjustments or repairs.

Also, be aware of water-efficient toilets when choosing appliances for new installation or remodeling projects. The difference between a toilet that uses only 2 gallons per flush and one that uses more than 5 gallons can be significant over the life of the appliance.

Student Supplement 3—Maximum Contaminant Levels and Lifetime Health Advisories

The currently registered pesticide active ingredients listed below are in various stages of federal regulation. Maximum Contaminant Levels (MCLs) are enforceable standards for public drinking water supplies. MCLs have been proposed for many high volume use pesticides (Table 1). MCLs are set to protect against adverse health effects and should be considered safe levels.

The Environmental Protection Agency also has set lifetime health advisories for many other pesticides occasionally found in groundwater (Table 2). Health advisories are not enforceable standards, but can be used to assess potential health effects. Health advisories include a 100 to 1000 fold margin of safety. Water containing pesticides at or below the lifetime health advisories should be considered safe for lifetime consumption.

Table 1. Pesticides with Proposed MCLs (ppb)

2	<i>alachlor</i> -Lasso®	5	1,2 <i>dichloropropane</i> -Propylene dichloride
3	<i>atrazine</i> -Atranex, Crisezina®	70	2,4-D-Auqa Kleen®
10	<i>aldicarb</i> -Temik®	200	<i>Pentachlorophanol</i> -PCP
40	<i>carbofuran</i> -Furdan, Curaterr®	400	<i>methoxychlor</i> -Malate®, DMDT, Methoxy-DDT

Table 2. Pesticide Lifetime Health Advisories (ppb)

60	<i>ametryn</i> -Ametrex, Gesapax®	0.2	1,3 <i>dichloropropene</i> -DCP, Telone
20	<i>bentazon</i> -Basagran®	1	<i>acifluorfen</i> -Blazer®, Carbofluorfen, Tackle®
700	<i>butylate</i> -R-1910, Sutan®	3	<i>baygon</i> -Propoxur, Unden®, Blattanex®
700	<i>carbaryl</i> -Sevin®	90	<i>bromacil</i> -Borea®, Hyvar®, Uragan®
10	<i>cyanazine</i> -Bladex	700	<i>carboxin</i> -D-735, DCMO, Vitavax®
200	<i>dalapon</i> -Dowpon, Ded-Weed®	100	<i>chloramben</i> -Amiben, Vegiben®
200	<i>dicamba</i> -Banvek®	2	<i>chlorothalonil</i> -Bravo, Daconk®
7	<i>dinoseb</i> -DNBP, Dinitro	0.6	<i>dlazinon</i> -Spectracide®, Basudin®, AG-500
200	<i>diphenamid</i> -Dymid®, Enide®	0.3	<i>disulfoton</i> -Disyston®, Dithiodemeton®
10	<i>diuron</i> -DCMU, Karmex®	0.2	ETU-Breakdown of EBDC pesticides
2	<i>fenamiphos</i> -Nemacur®	90	<i>fluormeturon</i> -Coloron®, C-2059
200	<i>Hexazinone</i> -Velpar®	0.02	<i>hexachlorobenzene</i> -HCB, Perchlorobenzene
100	<i>metolachlor</i> -Dual®, Primextra®	200	<i>methomyl</i> -Dupont 1179, Lannate®, Nudrin®
200	<i>metribuzin</i> -Lexone®, Sencor®	400	<i>methoxychlor</i> -Malate®, DMDT, Methoxy-DDT
200	<i>oxamyl</i> -Vydate®, DPX-1410	100	<i>prometon</i> -Gesafam®, Pramitol®
200	<i>Pentachlorophenol</i> -PCP	50	<i>pronamide</i> -Kerb®, Propyzamide
500	<i>pichloram</i> -Tordon®	90	<i>propachlor</i> -Bexton®, Pamrod®
100	<i>propham</i> -IPC, Beet-Kleen®	10	<i>propazine</i> -Gesomil®, Milogard®, Primatol P®
90	<i>terbacil</i> -Sinbar®	4	<i>simazine</i> -Princep®, Aquezine®
1	<i>terbufos</i> -Counter®	500	<i>tebuthluron</i> -Graslan®, Spike®
5*	<i>trifluralin</i> -TreflanR (*EPA letter)		

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Objective Sheet

Unit
Objective

After completing this unit, the student should be able to perform and interpret a soil test and read a soil survey and conservation plan map. The student should demonstrate these competencies by completing the assignment sheets and job sheet and by scoring a minimum of 85 percent on the written test.

Specific
Objectives

After completing this unit, the student should be able to:

1. Match terms related to land management with their definitions.
2. Distinguish between agricultural and non-agricultural land uses.
3. Match reasons soil is important with their description.
4. Complete statements concerning how soils are formed.
5. Match types of rocks with their definitions.
6. Match weathering factors with their actions.
7. Match types of soils with the ways they are deposited.
8. Select from a list the composition of an average soil.
9. Select from a list the functions of organic matter.
10. List the major factors that affect land capability classes.
11. Match the horizons of a soil profile with their description.
12. Match categories of soil texture with their description.
13. Match categories of soil depth with their description.
14. Match classes of slope with their description.
15. List the two types of erosion.
16. List causes of erosion.
17. Complete statements concerning the effects of erosion.
18. Select from a list the contributors to erosion pollution.
19. Match classes of erosion with their description.
20. Match types of soil structure with their description.
21. Match levels of permeability with their description.

Objective Sheet

22. Match classes of surface runoff with their description.
23. Match land capability classes with their description.
24. Select true statements concerning soil testing.
25. Distinguish between major and minor plant nutrients.
26. Identify nutrients in a fertilizer analysis.
27. List methods of controlling erosion on the farm.
28. Select from a list methods of controlling non-farm erosion.
29. Select from a list true statements concerning rangeland management.
30. Select true statements concerning reclamation of mined lands.
31. Distinguish between Global Positioning System (GPS) and Geographic Information Systems (GIS).
32. Select true statements concerning soil survey reports.
33. List parts of a conservation plan.
34. List parts of a land use planning summary.
35. List stewards of the soil.
36. Distinguish between the United States Department of Agriculture (USDA) and United States Department of Interior (DOI) roles in land management practices.
37. List career opportunities in land management.
38. Determine land capability classes. (Assignment Sheet 1)
39. Determine fertilizer composition and rates. (Assignment Sheet 2)
40. Read a soil test report. (Assignment Sheet 3)
41. Report on GIS/GPS technology and utilization. (Assignment Sheet 4)
42. Read a soil survey map. (Assignment Sheet 5)
43. Read a conservation plan map. (Assignment Sheet 6)
44. Complete a land use planning summary. (Assignment Sheet 7)
45. Take a lawn and garden soil sample. (Job Sheet 1)

Information Sheet

Key terms:

- **Topography**—The study of physical features (natural and man-made) on the land's surface
- **Land management**—The planning and implementation of practices applied to the land

Introduction

Life on this planet is very complex. We depend on many things for survival - air, water, shelter, food, and security. No single natural resource is more important to that survival than our land. The most valuable and productive part of the land is its surface layer- what we call soil. Every living organism directly or indirectly requires soil. It is the main source of the food supply because it supports and nourishes plants. Soil is a fragile resource. It can be easily damaged or lost. Many years are required to renew soil.

Some people call soil "dirt". Soil is not dirt! Dirt is misplaced soil; it is the soil on your clothing or floor. Dirt is something we do not want; soil is something that is essential. Nutrients in the soil help provide for the many needs of humans - food, clothing, and shelter. Studying soil can be a challenge. Soil scientists may spend entire lives learning more about the soil.

Soil is a basic natural resource used by humans to meet one or more of their needs. Land is limited in quantity and quality. It varies from place to place as a result of the interactions of climate and vegetation on geological materials as conditioned by **topography** over a period of time. Even small changes in any one of the soil forming factors can create a different soil. It is no wonder that so many kinds of soils exist. In learning and studying the land and soil we look for clues that tell us how well the land can produce crops or be used for other purposes. Soil characteristics, climate, and topography are good clues to the soil's capabilities, but close examination of the soil texture, depth, slope, erosion, structure, permeability, drainage, and flooding potential are necessary to classify land into capability classes.

In order to conserve soil a person must learn basic concepts about soil such as:

- what soil is,
- how it is developed,
- some functions of soil,
- why it is important to us, and
- **land management** practices to conserve and protect the land.

This unit teaches all of these concepts and offers further insight into soil's relationship with man, plants, and animals. It is only by understanding the nature of the soil that we can best manage it for both the present and the future.

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Information Sheet

Objective 1

Terms and definitions

Note: Please refer to key terms for definitions.

Contour	Slope
Depth	Soil
Erosion	Soil horizon
Land	Soil map
Land capability class	Soil profile
Land management	Soil structure
Land uses	Soil survey
Land use planning	Soil texture
Organic matter	Surface runoff
Permeability	Topography
Rangeland	Weathering
Reclamation	Windbreak

Objective 2

Agricultural and non-agricultural land uses

Key terms:

- **Land**—Any ground, soil or earth whatsoever, regarded as the subject of ownership, and everything annexed to it by nature or by man extending vertically upwards and downwards. (Legal definition)
Examples: Nature—trees, water, wildlife, etc. Man—buildings, fences, etc.
- **Land uses**—The systematic application of human controls to the key elements of an ecosystem in order to derive benefit.
Examples: Wildlife conservation, mining land for minerals, excavating land for homes and municipalities, producing agricultural crops, and harvesting trees from a forest.

a. Agricultural land uses:

- Crops
- Pasture for hay and grazing
- Forestry and woodlands
- Farmsteads and service areas

b. Non-agricultural land uses:

- Urban areas
- Highways and roads
- Railroad right of ways
- Airports
- State and national parks
- Wildlife areas
- National defense areas

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Objective 3

Reasons soil is important

Key term:

- **Soil**—The outer portion of the earth's crust that supports plant life
 - a. Plant growth—**Soil** provides nutrients for plant growth and contact with roots anchors plants.
 - b. Habitat for microbes—Soil provides a home to many microorganisms.
 Note: Microorganisms help renew soil. They decompose organic matter. This process restores nutrients to the soil and helps clean the environment of wastes.
 - c. Renew water—Movement of water through soil to the layers of earth below removes impurities from water.
 Note: Soil acts like a filter and is an important part of the water cycle.
 - d. Sites for structures—Soil serves as the part of the earth on which homes and other structures are built.
 - e. Reservoirs—Soil can be shaped into ponds and lakes to hold water.
 Examples: Sources of water for human consumption, recreation, sources of water for farming (livestock and irrigation), fish farming
 - f. Waste disposal—Structures built in the soil allow natural decay to occur.
 Examples: Landfills, septic tanks
 - g. Aesthetics—Soil allows the surface of the earth to be attractive.
 Examples: Natural landscapes; landscapes installed at homes, parks, and other sites

Objective 4

How soils are formed

- a. Soil begins as rock.
- b. Weathering factors work to break rocks down.
- c. Soil types are based upon the type of rock from which they are made.
- d. Rock particles are further broken into various smaller sizes of rocks and minerals.
- e. Small plants (lichens and mosses) begin to grow on the rock surfaces.
- f. Dead plant materials (organic matter) are mixed with rock fragments.

Information Sheet

Objective 5

- g. As more organic matter is formed, larger plant forms (ferns, grasses, and shrubs) take root.
- h. Bacteria and fungi break down the organic matter into simpler nutrients that are released into the soil, further aiding plant growth.

Note: This is a very slow process requiring years.

Types of rocks

- a. **Igneous**—Formed by hardening of molten volcanic materials
- b. **Metamorphic**—Formed as a result of changes in the other rocks under heat and pressure
- c. **Sedimentary**—Formed by a consolidation of particles laid down over the years

Objective 6

Weathering factors

Key term:

- **Weathering**—The actions that break down rock into soil
 - a. Temperature changes—Heating and cooling cause rock to crack.
 - b. Winds—Sand may be blown against a larger rock, eroding its surface.
 - c. Water—Water-soluble minerals are dissolved and eroded particles are carried away.
 - d. Chemicals—Chemicals dissolved in the soil water eat away rock surface.
 - e. Ice—Expansion of frozen water can cause rocks to break.
 - f. Glaciers—Flowing ice can move rocks and grind them into pieces.

Objective 7

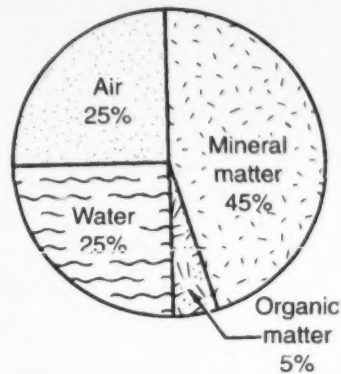
Ways soils are deposited

- a. Glacial soils—Deposited by glaciers
Example: Rich farmland soils of the Corn Belt
- b. Loess soils—Deposited by wind
Example: Rich Palouse soils of the Pacific Northwest
- c. Alluvial soils—Deposited by moving fresh water
Example: Delta regions at the mouth of rivers

Objective 8

Composition of an average soil

Figure 1



- a. Mineral matter—45%

Examples: Clay, silt, sand, gravel

Note: Mineral matter is a naturally-occurring inorganic substance in the soil.

- b. Water—25%

- c. Air—25%

- d. Organic matter—5%

Examples: Living and dead organisms

Note: These figures are for an average soil. Specific soils will vary.

Objective 9

Functions of organic matter

Key term:

- **Organic matter**—Plant and animal matter in various stages of decay

- a. Serves as a cementing agent for soil particles
- b. Returns plant nutrients to the soil
- c. Stores soil moisture
- d. Provides food for soil microorganisms (bacteria)
- e. Makes soil more tillable and able to support plant life

Information Sheet

Objective 10

Major factors that affect land capability classes

Note: These factors are conditions that keep land from being Class I.

- a. Texture
- b. Depth
- c. Slope
- d. Erosion
- e. Permeability
- f. Surface runoff

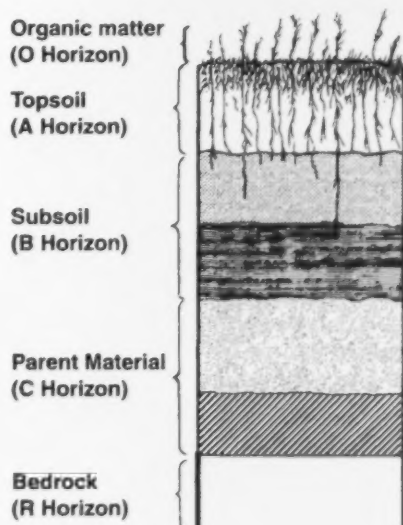
Objective 11

Horizons of a soil profile

Key terms:

- **Soil profile**—Side view or vertical cross-section of the soil
- **Soil horizon**—A layer of soil materials

Figure 2



- a. Organic matter—Plant and animal matter in various stages of decay

Note: O Horizon

- b. Topsoil—Humus, roots, organisms

Note: A Horizon

Objective 12

- c. Subsoil—Fine particles, leached materials, some roots

Note: B Horizon

- d. Parent material—Weathered bedrock and some leached materials

Note: C Horizon; Earth materials from which soil is formed

- e. Bedrock—Underlying solid rock

Note: R Horizon

Categories of soil texture

Key term:

- **Soil texture**—The relative proportion of sand, silt, and clay particles in a specific soil mass

Note: **Soil texture** is easiest to determine when the soil is moist. Sand feels gritty when rubbed by a finger. Silt feels slick or velvety. Clay is usually sticky and plastic when wet and when pinched between the thumb and finger becomes a flexible ribbon. Surface texture is normally determined from at least plow depth or 6 inches.

- a. Coarse-textured — Soils are loose, very friable, and the individual grains can be readily seen or felt. When moist, a mold may be formed which is unstable and crumbles as the soil is handled. When squeezed between thumb and forefinger, it feels gritty and will not ribbon or stain fingers. Squeezed when dry, it will fall apart as pressure is released.

Examples: Sand, loamy sand

- b. Moderately coarse-textured — Soil feels gritty but contains enough silt and clay to make moist soil hold together. The individual sand grains can readily be seen and felt. If squeezed when moist, a mold can be formed which can be carefully handled without breaking. When squeezed between thumb and forefinger it forms no ribbon or a very poor ribbon. Squeezed when dry, it will form a mold which breaks easily upon handling.

Examples: Sandy loam, fine sandy loam

- c. Medium-textured — Soils have a slightly smooth or velvety feel when moist. The mold formed by squeezing when moist can be handled freely, without breaking. When squeezed between thumb and forefinger it will form a ribbon with a dull surface. Squeezed when dry, it forms a mold than will bear careful handling.

Examples: Very fine sandy loam, loam, silt loam, silt

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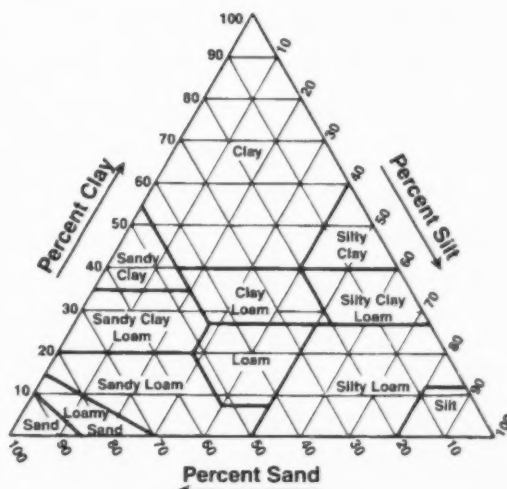
- d. **Moderately fine-textured** — Soils usually break into clods or lumps when dry. When moist soil is squeezed between thumb and forefinger, it crushes with some effort. It will form a short (1 inch to 1½ inch) well-formed ribbon with a shiny surface which will tend to break or the ribbon will bend downward.

Examples: Clay loam, sandy clay loam, silty clay loam

- e. **Fine-textured** — Soils form very hard, massive lumps or clods when dry, and are quite plastic and sticky when wet. When the moist soil is squeezed between the thumb and forefinger, it crushes with considerable effort and will form a long (2+ inches) ribbon which will support itself.

Examples: Sandy clay, silty clay, clay

Figure 3



Soil Textures and Their Particles

Objective 13

Categories of soil depth

Key term:

- **Depth**—The total thickness of the surface and subsoil plus any underlying material that is favorable for root development

Note: **Depth** determines the total amount of water held in soil, the volume of the soil available for plant root growth, and the supply of nutrients available to plants. Depth is total inches of soil that can be penetrated by plant roots.

- a. Deep—Over 40 inches
- b. Moderately deep—Over 20 inches but less than 40 inches
- c. Shallow—Over 10 inches but less than 20 inches
- d. Very shallow—Less than 10 inches

Objective 14

Classes of slope

Key term:

- **Slope**—The number of feet that the land rises or falls in a 100-foot horizontal distance

Example: A slope between two points that are 100 feet apart with a difference of 4 feet would have a 4% slope.

Note: **Slope** has a tremendous effect on water runoff, erosion, and use of farm machinery.

- a. Nearly level—less than 1 foot elevation change
- b. Gently sloping—1 to 3 feet elevation change
- c. Moderately sloping—3 to 5 feet elevation change
- d. Strongly sloping—5 to 8 feet elevation change
- e. Steep—8 to 15 feet elevation change
- f. Very steep—Over 15 feet elevation change

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Information Sheet

Objective 15

Types of erosion

Figure 4

a. Wind



Figure 5

b. Water



Objective 16

Causes of erosion

- a. Moving water
- b. Topography including slopes of the land
- c. Lack of vegetation
- d. Dry climate conditions
- e. Wind
- f. Human activities

Examples: Construction, mining, agriculture, recreation that disturbs or removes vegetation

Objective 17

Effects of erosion

- a. Reduces fertility of land
- b. Increases sediment in water bodies
- c. Increases water filtration expenses
- d. Destroys spawning beds of game fish
- e. Reduces fish food supply
- f. Fills pools where fish live
- g. Increases the damage caused by floods

Objective 18

Contributors to erosion pollution

- a. Riverbank erosion
- b. Farming erodible lands
- c. Unprotected construction sites
- d. Industrial and mining activities

Objective 19

Classes of erosion

Key term:

- **Erosion**—The wearing away of land surface

- a. None to slight—Soils of this class show no obvious effect of **erosion**. The plow layer exhibits characteristics of the "A" horizon. Less than 25% of the top soil has been removed and no gullies are present.
- b. Moderate—Soils of this class have 25% to 50% of the original topsoil present. The plow layer may consist of a mixture of the "A" horizon and underlying "B" horizon. Small rills and occasional, crossable gullies may be present.

Note: A crossable gully is one that can be crossed with normal, operating farm machinery.

- c. Severe—Soils of this class have been eroded to the extent that 75% of the original top soil is removed. The plow layer exhibits characteristics predominately of "B" horizon. Frequent crossable gullies, or occasional uncrossable gullies, or occasional wind blow-out are as may be present.
- d. Very severe—Soils of this class have over 75% of top soil removed with frequent uncrossable gullies and/or severe accumulations by wind. The plow layer exhibits characteristics predominately of "B" horizon. If wind is the main erosion force, blowouts are numerous and deep. Areas are unfit for crop production with extensive reclamation.

Information Sheet

Objective 20

Types of soil structures

Key term:

- **Soil structure**—The shape and arrangement of soil particles into clusters or aggregates.

Note: Each aggregate has a particular shape or size and determines the type of soil structure.

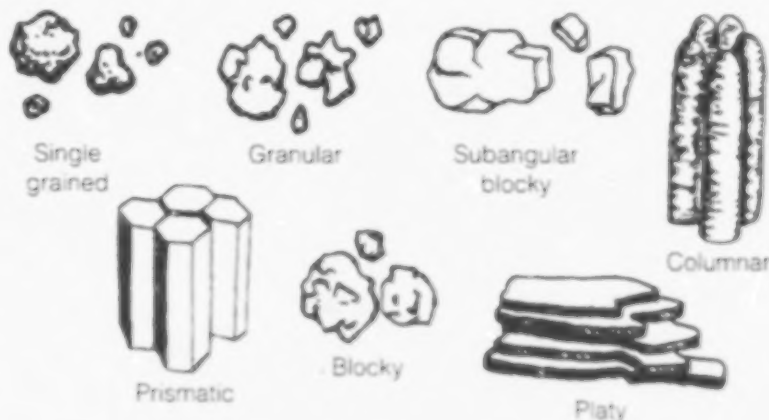
- a. Single grained—Each soil particle functions as an individual unit due to the lack of binding material

Example: Coarse-textured soils

- b. Granular—Sphere-like or rounded aggregate with no flat surfaces due to contact pressure from the faces of surrounding aggregates
- c. Subangular blocky—Block-like or tending toward six-faced aggregates having mixed, rounded and flat surfaces with many rounded vertices or corners
- d. Blocky—Block-like or tending toward six-faced aggregates having flat surfaces with mostly sharp, angular vertices or edges that are mold casts formed by surrounding aggregates
- e. Prismatic—Prism-like or vertically-oriented aggregates with the vertical axis much greater in length than the horizontal axis; flat surfaces or faces are well defined
- f. Columnar—Modified type of prismatic aggregate but with rounded surfaces; usually suggests salty conditions
- g. Platy—Plate-like or relatively thin horizontal plates or leaflets
- h. Massive—Indistinct or no apparent aggregation

Note: This type is characteristic of clayey, very slowly permeable soils.

Figure 6



Objective 21

Levels of permeability

Key term:

- **Permeability**—The movement of air and water through the soil

Note: **Permeability** is extremely important because it affects the supply of air, moisture, and soil nutrients in the root zone (upper 40 inches) available to the plant. The soil's permeability is determined by permanent characteristics such as texture, structure, and consistence.

- a. **Rapidly permeable**—Subsoils tend to be very friable or loose when moist, and exhibit little restriction of water or air.

Example: Coarse-textured subsoils that are granular or single-grained

- b. **Moderately permeable**—Subsoils are friable to very friable with large pores. Roots are abundant.

Example: Usually moderately coarse- and medium-textured subsoils

- c. **Slowly permeable**—Subsoils are firm when moist and firm when dry. Roots are common. Lengths differences of vertical and horizontal cracks are negligible.

Example: Moderately fine-textured subsoils with angular and subangular blocky structure

- d. **Very slowly permeable**—Subsoils are very firm when moist and very firm when dry. Roots are few and generally follow ped faces and cracks.

Example: Dense, fine-textured subsoils and claypan soils with coarse, angular blocky or massive structures

Objective 22

Classes of surface runoff

Key term:

- **Surface runoff**—The relative rate of water is removed by flowing over the soil surface.

Note: **Surface runoff** is the combined effect of soil slope, position in the landscape, permeability, and infiltration rate on runoff. This includes rainfall, as well as water from adjacent slopes.

- a. **Rapid**—Water is removed from the soil surface at a rapid rate.

Note: A large amount of rainfall is lost and only a small portion moves into the soil increasing the chances of erosion. This a result of compaction, clayey textures and/or slopes greater than 3% (except when the soils are rapidly permeable).

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Information Sheet

- b. Moderate—Water drains away readily but yet slow enough that a large amount of the water enters the soil.

Note: This condition causes little chance of erosion and is considered a normal amount of runoff. This condition occurs on slopes of 1% to 3% (except when the soils are rapidly permeable).

- c. Slow—Water flows away so slowly that free water covers the soil for moderate periods.

Note: This condition increases the moisture supply but may interfere with farming operation. This condition occurs on slopes of 0 to 1% and includes soils with moderate, slow, or very slow permeable subsoils.

- d. Very slow—Water is removed so slowly or stands so long that the soil remains wet for long periods.

Note: Most of the water either passes through the soil or evaporates. Generally this condition occurs on level to slightly concave slopes. However, deep sandy soils with rapidly permeable subsoils on slopes also have very slow runoff because the infiltration is so high that rainfall produces little or no runoff.

Objective 23

Land capability classes

Key term:

- **Land capability class**—The suitability of land for a specific agricultural use without permanent damage.

Note: When soil scientists classify land they consider factors such as texture, depth, slope, erosion, structure, and permeability.

- a. Class I—Land is very productive land that can be cultivated with minimal erosion control measures. It is nearly level, well to moderately well drained, deep medium textured, not subject to erosion or flooding, and easily cultivated.
- b. Class II—Land is suitable for all types of farming, but has some limitations. It may have a gentle slope, may suffer from the effects of past erosion, and may have less than ideal soil depth. It may also have some drainage problems, but these can be corrected by installation of drainage systems. This class of land requires careful soil management to prevent erosion damage.
- c. Class III—Land is moderately good land that can be cultivated and farmed regularly, but has some important limitations. It may have a moderate slope, and may be highly susceptible to erosion damage, and may have problems with drainage or have a shallow rooting zone which causes droughtiness. Terracing and other water control measures will be needed. This class of land should be farmed with care to control erosion.

- d. Class IV—Land has severe limitations, but can be cultivated with careful soil management practices. It may be strongly sloping and may be subject to moderate erosion. It may already suffer from past severe erosion, be very shallow, very dry, or very wet soil. Cultivated areas should be strip tilled, terraced and farmed on the contour. Best suited for pasture and hay meadows.
- e. Class V—Land is nearly level but has some soil property making it unsuitable for cultivation. It has little or no erosion hazard, but may be in a frequent floodplain. It may be very wet (swampy), very dry, or very rocky. This class of land is suitable for pasture, wildlife habitat, or forest production.
- f. Class VI—Land has serious limitations. It may have very rocky or very shallow usable surface soil, may have steep slopes, severe erosion, or already be suffering from severe erosion. This class is suitable for tree production, permanent pasture, wildlife habitat, and recreation.
- g. Class VII—Land has very severe limitations. It may be severely steep, have very coarse soil, and/or be severely eroded with large gullies. Establishing pasture may be impractical, but native grasses can be used for controlled grazing. This class is suitable for controlled grazing, forest production, wildlife habitat, and recreation.
- h. Class VIII—Land has one or more extreme limitations. The limitations may be a rock outcropping or an area with almost solid surface rock. River washes, stream beds, lake bottoms, sand dunes, and other nearly barren areas. This class of land can be preserved in its natural state for recreation and wildlife, but has little agricultural value.

Objective 24

Soil testing

- a. Soils differ in the amount of nutrients they can supply to plants.
- b. A soil test will estimate the amount of nutrients a soil can provide to a plant.
- c. Adding major plant nutrients based on a soil test can increase yield and will improve quality of the plant.
- d. Soil tests can also determine the pH of the soil and the soil texture.

Note: Alkalinity or acidity (pH) of a soil significantly affects how readily available plant nutrients are for plant growth.

Information Sheet

Objective 25

Plant nutrients

a. Major plant nutrients

- Nitrogen
- Phosphorus
- Potassium

b. Minor plant nutrients

Note: These nutrients are needed by the plant in very small quantities but are of major importance nevertheless. Most minor nutrients are available in sufficient quantities in the soil, although a soil analysis may detect deficiencies which need to be supplemented.

- Zinc
- Manganese
- Boron
- Copper
- Iron
- Molybdenum
- Calcium
- Sulfur
- Chlorine
- Magnesium

Objective 26

Nutrients in a fertilizer analysis

Note: Fertilizers are a mix of inert material and a percent of major nutrients. Some fertilizers have minor nutrients added to the mix based on the need.

- Nitrogen (N)—First nutrient represented in a fertilizer analysis
- Phosphorus (P)—Second nutrient represented in a fertilizer analysis
- Potassium (K)—Third and last nutrient represented in a fertilizer analysis

Examples: Fertilizer Analyses

33-0-0	=	33% N, 0% P, and 0% K
26-10-3	=	26% N, 10% P, and 3% K
10-20-10	=	10% N, 20% P, and 10% K

Objective 27

Controlling erosion on the farm

Key terms:

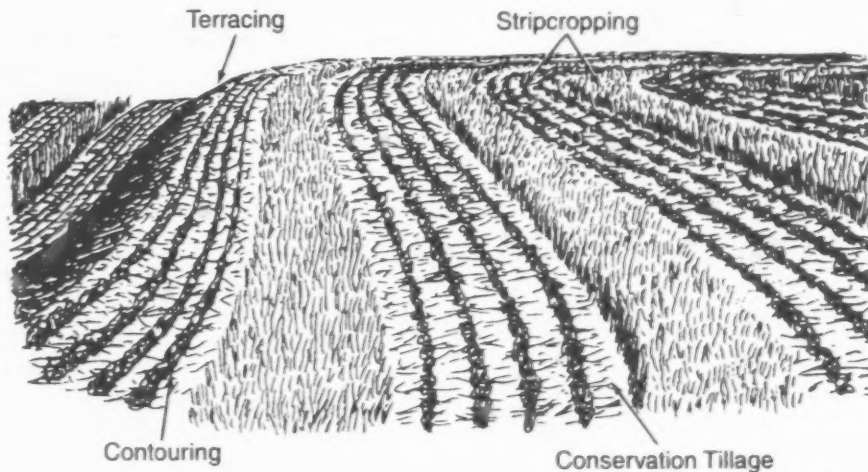
- **Contour**—An imaginary line along the ground connecting all points in the same elevation
- **Windbreak**—A living barrier of trees and shrubs designed for protection from wind and/or snow

- a. Plant buffer strips of perennial grasses to hold soil particles.
- b. Plant **windbreaks** to slow wind speeds.
- c. Ridge soil into small furrows to trap soil particles.
- d. Provide diversions to channel excess runoff.

Note: Diversions should be grassed to prevent erosion within diversion channel.

- e. Farm on the **contour** rather than straight-row up and down hills.
- f. Terrace to control and manage water runoff.
- g. Use contour stripcropping.
- h. Use rotation cropping.

Figure 7



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- i. Practice conservation tillage, which leaves a minimum of 30 percent of the previous crop's residue on the soil surface after planting.

Note: This can reduce erosion 50-90% compared with conventional tillage because the soil is not left bare. Crop residue is also beneficial to wildlife and moisture retention.

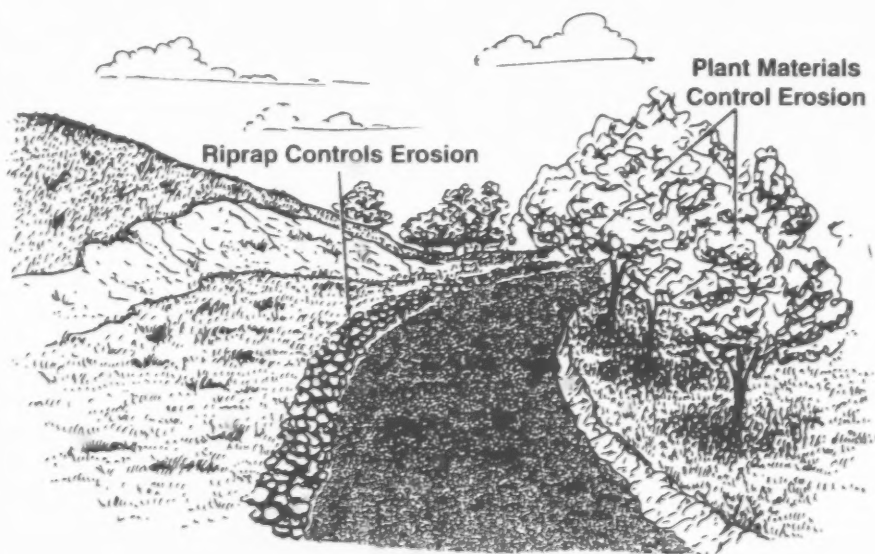
- j. Use tile drainage to remove excess underground water.
- k. Use grassed waterways to channel excess runoff.
- l. Mulch to hold soil in place.
- m. Prevent overgrazing of pastures and rangelands through proper grazing management.
- n. Use field borders of perennial vegetation to protect field edges.

Objective 28

Methods of controlling non-farm erosion

- a. Plant trees.
- b. Plant grass and ground covers.
- c. Place rock materials (rip-rapping) along riverbank to secure it.

Figure 8



- d. Leave vegetation on the soil as long as possible.
- e. Disturb only the minimum of a construction area.

Objective 29

- f. Cover bare spots with annual grasses, ground covers, sod, and mulch.

Note: Bare soil is very susceptible to erosion.

- g. Use erosion blankets or netting during construction or while waiting for grass seed to sprout.
- h. Protect slope from failure using jute matting, wooden strips placed across the slope, chemical-binding materials, grass, ground cover, or retaining walls.
- i. Use stormwater diversions, berms, waterways, and sediment basins to channel or slow down runoff.
- j. Base all building plans on scientific soil surveys.

Rangeland management

Key term:

- **Rangeland**—Refers to the land areas of the world that tend to be covered by grasses, grass-like plants, forbs, and shrubs as the primary vegetation instead of trees

Note: Rangeland may also be known as range, grassland, or prairie.

- a. Of the total land area on earth approximately 26% are managed as permanent pasture.
- b. Rangeland makes up about one-third of all the land in the United States.
- c. In the Southwestern United States as much as 85% of the land is considered rangeland, and as much as 90% of the rangeland is managed as pasture for grazing livestock.
- d. About 2/3 of the rangeland in the continental United States is privately owned or owned by state and local governments.
- e. The most productive and accessible rangeland is privately owned.
- f. The federal government owns the remaining 1/3 of the rangeland.
- g. The Bureau of Land Management manages most of the federal land, leasing much of it to ranchers for grazing livestock.
- h. There are three types of grasslands in the United States: tall grass prairies, transition prairies, and short grass prairies.
- i. Overgrazing is a condition that occurs in a range area when the grazing capacity is surpassed.

Information Sheet

Objective 30

- j. Overused grasslands result in damage to the soil, erosion, and reduced carrying capacities.
- k. The primary objectives of rangeland management is to produce the maximum amount of grazing for animals useful to humans, while protecting the land from damage due to overuse.

Reclamation of mined lands

Key term:

- **Reclamation**—Transforming barren areas as nearly as possible to their original condition after surface disturbance
 - a. Many mineral resources are obtained by surface mining.
Examples: Sand, gravel, stone, iron ore, coal, copper, uranium, phosphate, aluminum ore (bauxite), and gold.
 - b. Surface mining can be harmful to land.
 - Earth is left barren which encourages erosion.
 - Rivers and streams become choked with sediment.
 - Water that drains through the mines becomes polluted with chemicals.
 - c. Because of erosion problems, surface strip-mines are required to have a **reclamation plan**.
 - d. Reclamation activities
 - Earth-moving equipment fills the mined area with rock debris.
 - The land is shaped until it resembles the original contour.
 - Topsoil is spread over the area.
 - Trees, shrubs, and a mixture of grass suitable for the region are planted.

Objective 31

Global Positioning System (GPS) and Geographic Information Systems (GIS)

- a. Global Positioning System (GPS)
 - Network of satellites that are designed to help ground based units determine their current location in latitude and longitude coordinates
 - The GPS was implemented and is managed by the U.S. Department of Defense

- A receiver is designed to obtain positioning information from several satellites simultaneously, and perform the calculations necessary to determine your current location.
- There is no user fee or license required to operate a civilian GPS receiver.

b. Geographic Information System (GIS)

- Designed for the collection, storage, and analysis of objects and phenomena where geographic location is an important characteristic or critical in the analysis

Example: The location of a landfill or location where soil erosion is most severe are key considerations in using a GIS. In each case, what it is and where it is are very important to the user for analysis.

- A true system includes data, computer, hardware, software, and users
- Map overlay is probably the most common function.
- Examples of agricultural uses include:
 - Prediction of crop production — provide crop yields or production for a specific area
 - Land use changes — illustrate changes that have occurred and provide comparisons
 - Prediction of farm equipment needs — can help forecast tillage changes, crop changes and other factors
 - Calculation of crop losses — could be due to drought, flooding, or hail damage
 - Site-specific, variable rate systems — determine specific seed, nutrient, or pesticide needs for different areas of a field
 - Calculation of fertilizer/chemical needs — predict the amount of fertilizer or pesticide needed for a specific geographic area
- Linked with GPS technology, GIS is used to apply variable rates of seed, fertilizer, and pesticides. GIS/GPS technologies are also used for field scouting, crop records, and continuous on-the-go yield mapping.

Information Sheet

Objective 32

Soil survey reports

Key term:

- **Soil survey**—The systematic examination, description, classification, and mapping of soils in the area
 - a. Contain aerial photograph maps of an entire county and indicate all soil types with soil map symbols or numbers that correspond to a legend of soil types
 - b. Give descriptions of soils in that county
 - c. List management information to assist in land use planning
 - Agricultural data such as potential crop yield of a given soil type
 - Engineering data such as suitability of a soil for roads or other civil structures
 - Planning data such as suitability of a soil for homesites

Objective 33

Parts of a conservation plan

Key term:

- **Soil map**—A map showing the distribution of soil types
 - a. **Soil map**
 - b. Land use
 - c. Soil type and symbols
 - d. Acres
 - e. Capability class
 - f. Slope
 - g. Planned conservation treatment

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Objective 34

Parts of a land use planning summary

Key term:

- **Land use planning**—A political process to determine the uses of a given land

- a. Field number or name
- b. Acres
- c. Land use

Examples: Hay land, wildlife, farmstead, rangeland, pasture land

- d. Planned practices

Objective 35

Stewards of the soil

- a. Private landowners
- b. Research and education groups
 - Land-grant colleges
 - Cooperative Extension Services (state and county)
 - Agricultural experiment stations
 - High school agricultural education programs
 - Youth organizations—FFA, 4-H
- c. Government agencies
 - USDA — private lands
 - Natural Resources Conservation Service
 - State and district soil and water conservation offices
 - Forest Service
 - DOI — public lands
 - Bureau of Land Management
 - Bureau of Indian Affairs
 - National Park Service
 - U.S. Geologic Survey
 - Bureau of Reclamation
 - U.S. Army Corps of Engineers

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Information Sheet

Objective 36

United States Department of Agriculture (USDA) and United States Department of Interior (DOI) roles in land management

a. USDA

- Implements legislation and provides resources toward conservation on private lands

Examples: Land owned by farmers and ranchers and local and state governments

- Responds to a broad range of emerging natural resource challenges faced by farmers and ranchers, including soil erosion, wetlands, wildlife habitat, and farmland protection
- Provides a portfolio of voluntary assistance, including cost-share, land rental, incentive payments, and technical assistance.
- Emphasizes conservation of working lands, ensuring that land remain both healthy and productive

Conservation Provisions Overview — Farm Bill 2002

Source: www.usda.gov/farmbill

For more information contact: Local USDA Service Center or your local conservation district office.

- ✓ Agriculture Management Assistance (AMA)
- ✓ Conservation Corridor Program
- ✓ Conservation of Private Grazing Land (CPGL)
- ✓ Conservation Reserve Program (CRP)
- ✓ Conservation Security Program (CSP)
- ✓ Desert Terminal Lakes
- ✓ Environmental Quality Incentives Program (EQIP)
- ✓ Farmland Protection Program (FPP)
- ✓ Grasslands Reserve Program (GRP)
- ✓ Grassroots Sourcewater Protection
- ✓ Great Lakes Basin Program for Soil Erosion and Sediment Control
- ✓ Ground and Surface Water Conservation
- ✓ Partnerships and Cooperation
- ✓ Resource Conservation and Development Program (RC&D)
- ✓ Small Watershed Rehabilitation
- ✓ Wetlands Reserve Program (WRP)
- ✓ Wildlife Habitat Incentives Program (WHIP)

b. DOI

- Is the nation's principal conservation agency for public lands owned by the federal government

Note: The federally-owned public lands include National Parks and National Forests, lands managed by the Bureau of Land Management, and U.S. Fish and Wildlife Service refuges.

- Is the steward and guardian of our nation's natural resources and cultural heritage
- Manages 507 million acres or 1/5 of the surface land in the United States

Note: The Bureau of Land Management manages 262 million acres or 11% of federally-owned lands. These public lands are used for recreational purposes such as fishing, hiking, off-road vehicle use, and camping; commercial uses such as mining, grazing, forestry, power transmission right-of-ways, scenery for advertising, and motion picture filming; and conservation of plant, fish, and animal specimens and habitats, wild horse and burro ranges, archaeological and historic properties.

- Has eight bureaus to provide management services

Note: For more information contact your state's bureau office or go to web site www.doi.gov

- Bureau of Land Management
- U.S. Fish and Wildlife Service
- National Park Service
- Bureau of Reclamation
- Office of Surface Mining
- Minerals Management Service
- U.S. Geological Survey
- Bureau of Indian Affairs

Information Sheet

Objective 37

Career opportunities in land management

- a. Soil conservationist
- b. Soil conservation technician
- c. Soil scientist
- d. Soil engineer
- e. Range specialist (Extension Service, or private/public agencies)
- f. Range scientist
- g. Wildlife conservationist
- h. Ranch manager
- i. Farmer

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Student Supplement 1—Fertilizer Analysis

Whether one is growing houseplants, a suburban lawn, or thousands of acres of wheat, the use of fertilizer is necessary to provide proper plant growth and health. Plants require three basic nutrients for survival: nitrogen (N), phosphorus (P), and potassium (K). Other trace elements are necessary for plant growth also, but they are needed in only minute amounts, and in most cases these elements—boron, manganese, sulfur, iron, zinc, and others usually are found naturally-occurring in sufficient quantities in most soils.

Although a controversy exists between "organic" growers and more traditional growers who use fertilizers produced synthetically, plants distinguish no difference between nitrogen derived from cow manure or nitrogen derived from natural gas. In all cases, the plant can only take up nitrogen in the nitrate or ammonium form, and regardless of the source, any nitrogen used by a plant has to be in one of those forms. So-called "organic" fertilizers must be converted by soil microbes to a nitrate form before the plant can use them, whereas ammonium nitrate is readily available to the plant immediately.

The basis of modern agriculture's ability to feed the industrialized world as well as much of the developing populations is commercially-produced fertilizer. To use naturally occurring fertilizers such as manures to produce the quantities of food required today, would require many more animals than exist and would require the shifting of many fields currently growing human food to fields producing forages and grains for animals. Still, the controversy over fertilizer sources exists and probably will continue for the foreseeable future.

Given the plant's need for N, P, and K, most fertilizers are blended to meet those needs in some fashion.

Chemicals such as monoammonium sulphate, ammonium nitrate, urea, diamonium phosphate, and mured potash are combined in quantities to equal certain percentages of N, P, and K. The "analysis" or the content of such fertilizer is denoted on the bag or bulk order as a numerical ratio. For instance, 5-10-5 would denote a fertilizer mixture consisting of 5 percent N, 10 percent P, and 5 percent K. 34-0-0 would be 34 percent N, and zero P and K.

Any mixture containing all three basic plant nutrients is referred to as a "balanced" fertilizer, although continuous use of such mixtures does not assure proper plant nutrition year in and year out. For instance, on a bermudagrass lawn in the south, the use of a 10-20-10 fertilizer over a period of years will lead to a buildup of P and K in the soil. Bermudagrass is a vigorous consumer of nitrogen, which moves in the soil with water infiltration and can evaporate into the atmosphere if it is not taken up by a plant. But, P and K are relatively stable in the soil, not moving with infiltrating water, and needed in only small quantities for proper root growth and water handling abilities of the bermudagrass plant. So, with several years of application, the 10-20-10 fertilizer is meeting the nitrogen needs of the grass, but the P and K components are being wasted because they are being applied in far greater amounts than the plant can consume. And, not being consumed they build up in the soil. Although no evidence is found that this is harmful, it is wasteful and expensive.

Student Supplement 1

The only way to properly use such fertilizer is to perform regular soil tests and have laboratory analysis, based on the plant being grown, to guide one on amounts and types of fertilizer to be applied.

For nitrogen fertilizers, several chemicals are used because of their varying concentrations of N. For instance, ammonium nitrate provides about 33 percent of its weight in actual nitrogen. Urea contains 46 percent nitrogen. Anhydrous ammonia (NH_3), a pungent gas that must be incorporated into the soil with special applicator knives, is 82 percent nitrogen.

Various fertilizer combinations are available for various uses.

Examples include:

- Ammonium nitrate (34-0-0)—Usually applied to lawns and gardens. Seldom used agriculturally because of its greater cost per pound of nitrogen than other alternatives
- Diammonium phosphate (18-46-0)—A popular agricultural fertilizer which, with one compound, can supply two of the important plant nutrients, N and P
- Urea (46-0-0)—A lawn and agricultural fertilizer
- Anhydrous ammonia (82-0-0)—An agricultural fertilizer, usually providing the lowest nitrogen cost per pound
- Triple 17 (17-17-17)—A popular agriculture fertilizer blend
- 5-10-5—A popular lawn and garden fertilizer
- 10-20-10—A popular lawn and garden fertilizer
- 15-30-15—Miracle Gro® All Purpose Plant Food

Although fertilizer-is-fertilizer, the cost of certain ingredients can make one blend much more attractive than others. For instance, a farmer might want to put 50 lbs. of actual nitrogen per acre on a 100 acre field. Using 10-20-10 purchased in bulk for \$200 a ton the farmer would have to use 500 lbs. of 10-20-10 per acre (10 percent nitrogen $\times$ 500 = 50 lbs.) at \$50 per acre, or a total cost of \$5,000 to accomplish this goal. At the same time the use of 10-20-10 would also apply 100 lbs. of P and 50 lbs. of K, whether it was needed or not. At the local co-op, the farmer can arrange to purchase anhydrous ammonia for \$200 per ton, and with an N analysis of 82 percent, apply about 61 lbs. per acre to accomplish the same goal. That application would cost \$6.10 per acre or a total of \$610 to do the same thing the \$5,000 application of 10-20-10 would accomplish. (2000 lbs. anhydrous ammonia at \$200 = 10 cents per lb. $\times$ 61 lbs. per acre $\times$ 100 acres = \$610.)

If one knows the cost per pound of plant nutrients, the cost scenarios can be applied to lawn and garden fertilizer for considerable savings for the home and garden.

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Unit Contents

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* Assignment Sheets are located in the Student Workbook.

Objective Sheet

Unit
Objective

After completing this unit, the student should be able to describe the environmental effects and health hazards associated with air pollution, research environmental problems in air resource management, and formulate weather forecasts. The student should demonstrate these competencies by completing the assignment sheets and by scoring a minimum of 85 percent on the written test.

Specific
Objectives

After completing this unit, the student should be able to:

1. Match terms related to air resource management with their definitions.
2. Select from a list the composition and percentages of air components (unpolluted).
3. Select true statements concerning the importance of air quality.
4. Match air pollutants with their characteristics and health hazards.
5. Complete statements concerning the environmental effects of air pollution.
6. Select true statements concerning indoor air pollution.
7. Match indoor air pollutants with their characteristics.
8. Describe the Clean Air Act Amendments of 1990.
9. List methods of controlling motor vehicle emissions.
10. Match the types of pollution control measures that the government may impose on polluters to achieve compliance with environmental regulations with their descriptions.
11. List methods of controlling air pollution from industry and electrical power generating plants.
12. Select true statements on air quality trends in the United States.
13. Discuss global considerations in air resource management.
14. List the factors that cause weather.
15. List career opportunities in air resource management.
16. Locate sources of air pollution in your area. (Assignment Sheet 1)
17. Write a report on an environmental problem related to air quality. (Assignment Sheet 2)
18. Maintain a weather log for 10 days. (Assignment Sheet 3)
19. Formulate weather forecasts. (Assignment Sheet 4)

Information Sheet

Key terms:

- **Air**—A mixture of invisible, odorless, and tasteless gases that surround the earth
- **Atmosphere**—The mass of air surrounding the earth held by the force of gravity
- **Pollutant**—Any introduced gas, liquid, or solid that makes a resource unfit for a specific purpose
- **Pollution**—The presence of matter or energy whose nature, location, or quantity produces undesirable environmental effects

Introduction

Air is all around us. All living things must have air. We breathe it and live in it. From birth to death, people breathe — the process of inhaling and exhaling air from the lungs. Everyday the average adult breathes 3,000 gallons of air. People never stop breathing because the body must have air. A few minutes pause can result in a deficiency of oxygen and damage to the brain or death. Our health depends upon having good air. People get sick when the air has too much **pollution**. In breathing, a person takes into the body whatever is in the air. The body has a few means of filtering air, such as cilia in the nose to remove some dust. Overall, the body's filters cannot remove many of the harmful substances in the air.

Air is the mixture of gases that surrounds the earth. It is invisible, odorless, and tasteless. Air that can be seen, smelled, or tasted has been polluted with other materials. Polluted air may contain substances that are hazardous to the health of living things.

Air is never pure. It always contains substances in amounts that may vary slightly from one time to another. When we think of high quality air, we are usually thinking of air that is good to breathe and is free of harmful substances. Natural processes on Earth create some pollution, such as the release of methane by decaying vegetation.

Air forms the **atmosphere**. This creates weather conditions that lead to cold fronts, rain, and storms. As wind, air movement creates power that can be captured to do work. Even though it is made of gases, air can support weight.

It is important to remember that the gases in the air form a mixture, not a chemical combination. The gases can be identified and separated. However, some gases do react with **pollutants** to create compounds, such as when we have acid rain.

Millions of people live in areas where urban smog, very small particles, and toxic pollutants pose serious health concerns. These health concerns can stem from either short-term or long-term exposure to air pollution. When people have a short-term exposure to air pollutants above certain levels, they may experience temporary health concerns, such as eye irritation and burning, throat irritation, and difficulty breathing. Long-term exposure to air pollution can

Information Sheet

cause chronic health concerns, such as cancer and damage to the body's immune, neurological, reproductive, and respiratory systems.

The problem of air pollution is also found outside of major urban centers. Air pollution can be wide-ranging as well as persistent. Many air pollutants, such as those that form urban smog and toxic compounds, remain in the environment for long periods of time. These air pollutants can also be carried hundreds of miles by winds and can thus affect areas far-removed from the source of pollution.

We use air to breathe, to grow plants, to fly airplanes, to power windmills, to dry food and clothes. We can damage the air with pollution. We can even make it unusable, but we can not use it up. For all practical purposes, air is a non-exhaustible natural resource. Therefore, maintaining good air is important to all living things.

Objective 1

Terms and definitions

Air
Air quality
Air quality standards
Ambient air
Atmosphere

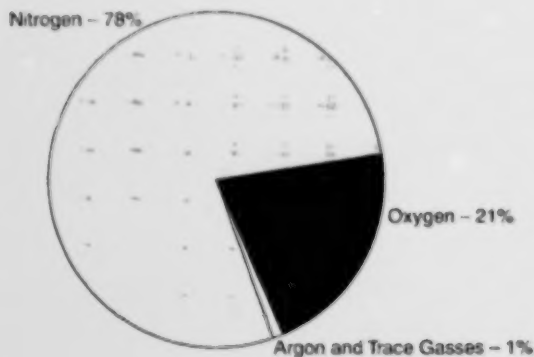
Point source air pollution
Pollutant
Pollution
Weather

Objective 2

Composition and percentages of air components (unpolluted)

Figure 1

- a. Nitrogen 78%
- b. Oxygen 21%
- c. Trace gases 1%
 - Argon 0.9%
 - Trace amounts 0.1% of the following gases:
 - Carbon dioxide
 - Nitrous oxide
 - Organic vapors
 - Hydrogen
 - Methane
 - Neon
 - Helium
 - Xenon
 - Krypton



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Objective 3

Importance of air quality

Key terms:

- **Air quality**—The suitability of the air for use by living organisms.
Note: Air with high quality is free of pollution; air with low quality contains hazardous materials.
 - **Ambient air**—The air or atmosphere outside
 - **Air quality standards**—The maximum level of atmospheric pollution allowed at one time in a geographical area.
 - a. Air with high quality is free from pollution.
 - b. Air with low quality contains hazardous materials.
 - c. All people have access to **ambient air**.
 - d. The Environmental Protection Agency (EPA) has **air quality standards** for the maximum amount of pollution that can be in ambient air.
 - e. Fans that exchange inside air and ambient air should be used only if they improve the quality of the inside air.
 - f. The quality of inside air is related to what is released into it.
- Examples: Cigarette smoke, candles, potpourri, aerosol sprays, manufacturing processes
- g. **Air quality** in the work environment is covered by standards set by the Occupational Safety and Health Administration (OSHA).

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Information Sheet

Objective 4

Air pollutants and their characteristics and health hazards

Air Pollutants	Health Hazards
a. Particulate matter	
- Finely divided solid or liquid particles in the smoke, and fumes - Caused by steel mills, power plants, cement plants, grain elevators, dirt roads, fireplaces, all types of burning, agricultural practices, construction, and use of diesel engines	Contributes to eye and throat irritation, bronchitis, lung damage, and impaired visibility.
b. Ozone (O₃)	
- A pungent, colorless, toxic gas - Produced when sunlight hits air compounds (VOCs) and nitrogen oxides which are released from fossil fuel combustion (primarily vehicles); also a natural byproduct of lightning	Serious respiratory problems such as breathing difficulties, asthma, reduced lung function, eye irritation, nasal congestion, and reduced resistance to infection
Major component of smog	
c. Carbon monoxide (CO)	
- A colorless, odorless, highly toxic gas. Can be deadly in small quantities if breathed over a certain period of time - Is produced by incomplete fossil fuel combustion, primarily in motor vehicles	Impairs ability of blood to carry oxygen; affects heart, lungs, and nervous system
d. Sulfur dioxide (SO₂)	
- A heavy, pungent, colorless gas - Formed primarily through the burning of coal, fuel oils, and wood - Major contributor to acid rain	Respiratory tract problems (acute and chronic); permanent damage to lung tissue

Information Sheet

Air Pollutants	Health Hazards
e. Nitrogen dioxide (NO₂)	
- An invisible gas produced when oxygen in the air combines with nitric oxide that is produced by fossil fuel combustion, primarily in motor vehicles - Major contributor to smog and acid rain	Respiratory illness and lung disease
f. Lead (Pb) (Airborne)	
- Exists in particles small enough to be carried by air current - Generated primarily by auto-mobiles using leaded gas-oline. Currently, this source of lead has become incon-sequential because most vehicles now operate with unleaded fuel	Causes brain damage and serious physical and mental impairment, especially in children

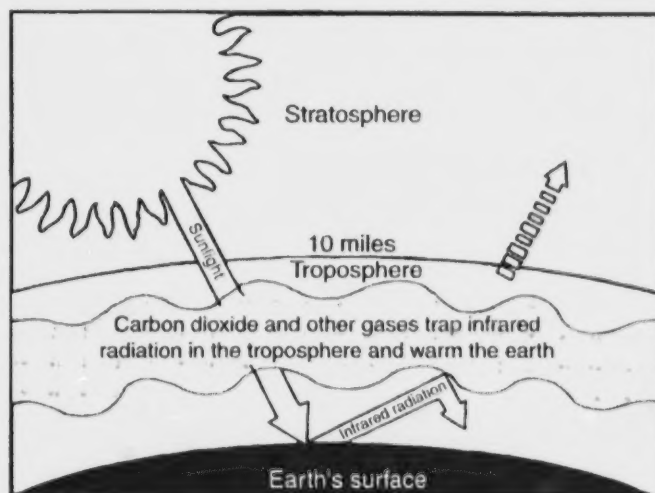
Objective 5

Environmental effects of air pollution

a. Greenhouse effect

- The greenhouse effect traps heat from the sun.
 - A layer of carbon dioxide and other gases above the earth's surface acts like a glass on top of a greenhouse.
 - Heat radiated from the sun passes through the carbon dioxide layer.
 - Part of the heat is trapped by the carbon dioxide layer; the rest is radiated back to the atmosphere.

Figure 2



- Many scientists believe that an increase in the atmospheric concentration of carbon dioxide can eventually cause an increase in the earth's surface temperature—global warming. Others point out as carbon dioxide levels increase, plant growth also increases, thereby holding the harmful effects of the "greenhouse effect" to a minimum.
- Theoretical effects of global warming
 - Sea levels could rise due to the melting of polar ice caps and the expansion of heated oceans.
 - As sea levels rise, coastal areas would erode and be covered by water.
 - Natural ecosystems would be greatly affected.
 - The excess heat would make many agricultural areas arid and nonproductive.

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Note: Although many scientists are convinced the greenhouse effect will cause global warming because of rapid increases in the amount of various greenhouse gases during the past century, no evidence has been found to date to indicate actual global warming is taking place. Satellite data from the past ten years and water and air temperatures collected from ships from 1856 to 1986 show no evidence of a warming trend. So far, estimates and predictions of such changes are based on computer models using statistics as tools to predict change. In actuality, however, hard evidence shows the earth's surface has warmed less than 1 degree Fahrenheit during the past century. Also, geological and archeological evidence indicates the earth goes through a cooling and warming cycle about every 200 years based on solar activity. If the current 200-year cycle repeats itself, many scientists believe the earth will cool about 2 degrees in the next century.

- Causes of the greenhouse effect—Increased carbon dioxide concentrations from
 - Natural decay of all vegetation
 - Burning fossil fuels
 - Burning organic matter (plants and animal waste)
 - Burning forests (deforestation)
- Solution to the problem
 - Use less fossil fuels.
 - Reduce forest burning practices.
 - Convert to nonfossil fuels such as nuclear, solar, and wind energy.

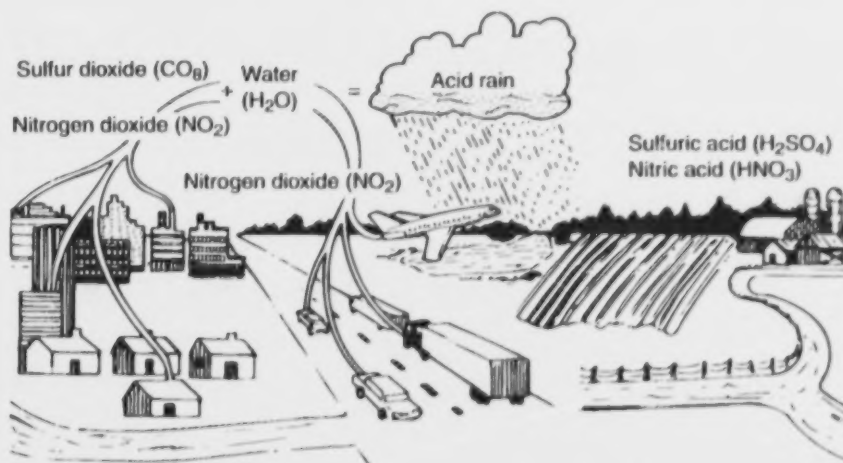
b. Acid rain

- Acid rain is atmospheric moisture which absorbs acid particles and falls to the earth. It has a pH value of less than 5.6.
 - The acid rain process begins with the emissions of sulfur dioxide and nitrogen dioxide from coal-burning electric power plants and automobile exhaust.
 - Sulfur dioxide (SO_2) combines with water (H_2O) to produce sulfuric acid (H_2SO_4).
 - Nitrogen dioxide (NO_2) combines with water (H_2O) to produce nitric acid (HNO_3).

Information Sheet

- Winds transport airborne acid particles hundreds of miles across state and national borders.

Figure 3

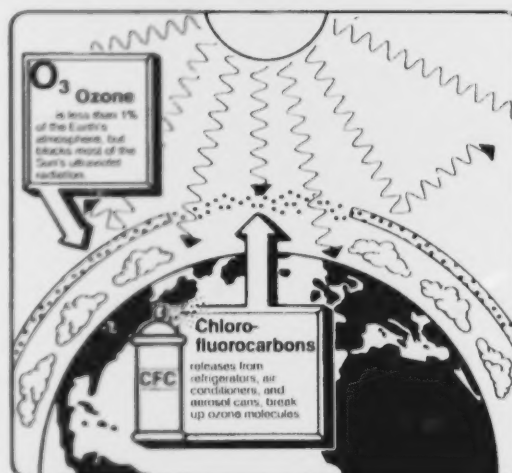


- Effects of acid rain
 - Acid rain causes surface waters and soils to become more acidic.
 - Acidic water disrupts the reproductive cycles of fish.
 - Acid rain leaches metals from soils and harms fish, aquatic plants, and microorganisms when these metals reach lakes and streams.
 - Acid rain adversely affects forests and agriculture.
- Solutions to the problem
 - Burn less coal.
 - Reduce automobile emissions.
 - Convert to cleaner fuels such as natural gas, nuclear, solar, or wind energy.
 - Develop more efficient emission control devices.

c. Ozone shield

- The ozone shield is a layer of ozone in the stratosphere 6 to 30 miles above the earth.
 - The ozone shield protects all earth organisms from dangerous ultraviolet radiation from the sun.
 - The ozone shield is thought to be depleted by synthetic chemicals known as chlorofluorocarbons (CFCs).

Figure 4



- CFCs are compounds consisting of chlorine, fluorine, and carbon which attack and destroy ozone molecules.
 - CFCs are used as agents for producing plastic foam, coolants for refrigerants and air conditioners, propellants for aerosol sprays, and cleansers for electrical parts.
- Note:** Most CFCs are now banned by international treaty.
- Nitrogen oxides from combustion of fossil fuels also remove ozone from the stratosphere.
- Effects of ozone shield depletion
 - As ozone is depleted, increased amounts of ultraviolet (U.V.) radiation from the sun strike the earth.
 - Increased U.V. radiation causes skin cancer, decreases crop yields, reduces fish populations, and contributes to smog.

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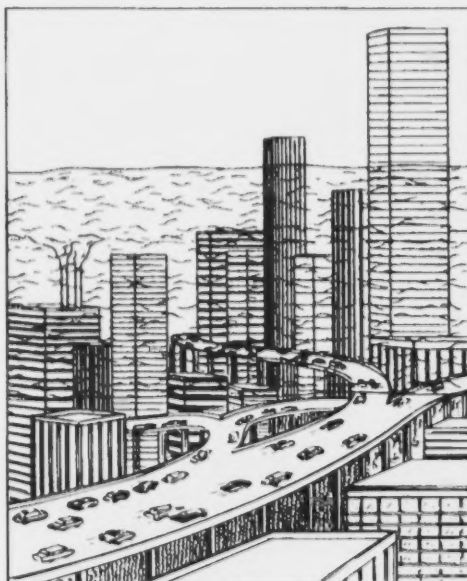
- Solutions to the problem

- Reduce the use and disposal of CFCs.
- Reduce nitrogen oxide emissions from fossil fuel combustion.

d. **Smog**

- Smog is a combination of smoke and fog forming an atmosphere polluted with industrial emissions and automobile exhaust.

Figure 5



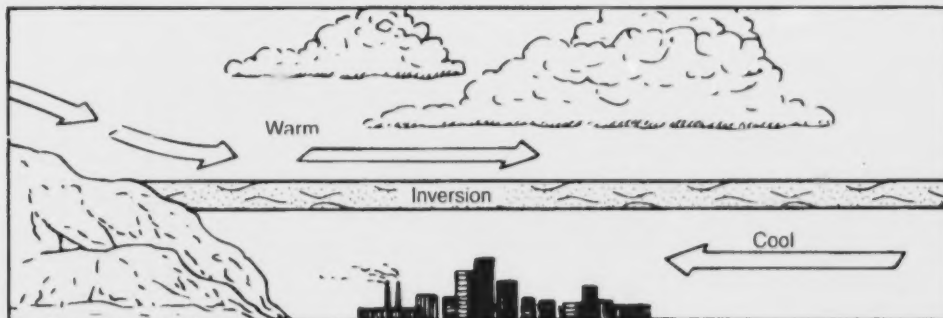
- Smog is generally confined to high population areas.
- Smog can be carried by winds and affect downwind rural areas.

Information Sheet

- Smog is more severe when accompanied by temperature inversions— when a layer of cool air is trapped by an upper layer of warm air.

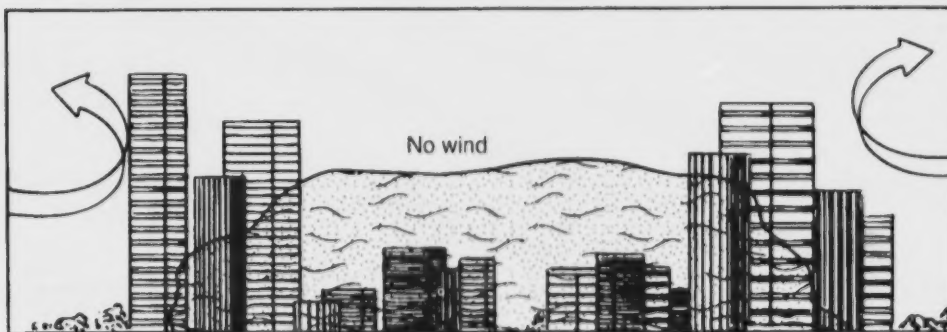
Note: Inversions hold polluted air closer to the ground.

Figure 6



- Smog is also more severe in stagnant air conditions where dilution by fresh air is minimized.

Figure 7



• Effects of smog

- Trace heavy metals (lead, zinc, iron, cadmium) in smog cause serious health problems.
- Numerous deaths are reported each year from smog, especially among those with respiratory illnesses.
- People with respiratory problems are forced to stay indoors.
- Smog reduces visibility contributing to traffic accidents.

Information Sheet

Objective 6

- Solutions to the problem
 - Improve and maintain automobile emission controls.
 - Control industrial emissions.
 - Convert to cleaner energy sources.

Indoor air pollution

- a. Indoor air pollution is a major health problem in the United States.
- b. Indoor pollutant levels are frequently higher than outdoor concentrations.
- c. Most people spend 90% of their time indoors.

Examples: At home, school, work, indoor social/recreational activities
- d. Ventilation of buildings is important to reduce indoor pollution.
- e. New homes and buildings, tightly constructed to conserve energy, are more likely to have air pollution problems.
- f. Short-term health effects of indoor air pollution
 - Eye, ear, nose, and throat irritations
 - Fatigue
 - Headaches
 - Irritability
 - Forgetfulness
 - Nausea
- g. Long-term health effects
 - Permanent respiratory damage
 - Impairment of the nervous system
 - Cancer

Objective 7

Indoor air pollutants and their characteristics

- a. Radon
 - Radon is a naturally-occurring gas emitted from radioactive decay of the element radium.

- Radium is found in many types of rocks and soils.
 - Radon enters buildings through foundation cracks or seams, floor drains, and slab joints.
 - Radon is inhaled into the lungs, increasing the risk of lung cancer.
 - Radon is estimated to cause between 5,000 and 20,000 deaths per year in the United States.
 - Radon cannot be seen or smelled. However, it can be detected with specialized equipment and laboratory analysis.
 - Radon concentrations in buildings can be reduced with forced-air ventilation systems.
- b. Environmental tobacco smoke
- Environmental tobacco smoke is smoke that nonsmokers are exposed to in the environment.
 - Tobacco smoke contains numerous pollutants such as gases, heavy metals, particulates, and products of incomplete burning.
 - Environmental tobacco smoke is reportedly linked to heart disease, lung cancer, and other health disorders.
 - It is estimated that from 500 to 5,000 nonsmoker deaths per year are linked to environmental tobacco smoke.
- c. Formaldehyde and other organic compounds
- Formaldehyde is found in furniture, foam insulation, and pressed wood products such as particle board.
 - Organic compounds are found in tobacco smoke, dry-cleaned clothes, paints, and cleaning compounds.
 - Health problems are eye and nose irritation and respiratory ailments.
 - Sources of these contaminants should be located and removed.
- d. Biological pollutants
- Heating and air conditioning systems can be breeding grounds for biological pollutants such as fungi, viruses, and bacteria.
 - Heating and air conditioning systems can bring outdoor biological contaminants such as pollen and mold inside.
 - Biological contaminants can cause viral infections and allergic reactions.

Information Sheet

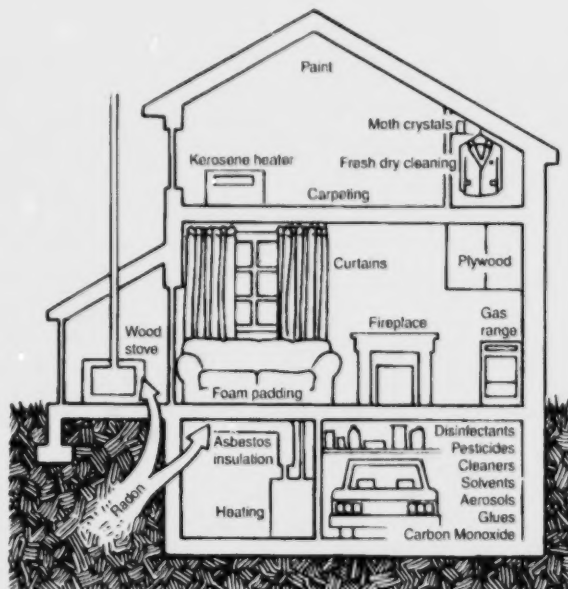
e. Pesticides

- Pesticides are chemicals used to destroy pests.
- Indoor and outdoor use of pesticides can be responsible for indoor air pollution.
- Even when used as directed, pesticides may pose a health threat.
- Pesticide exposure in sufficient quantities may cause cancer, birth defects, and other chronic health problems.

f. Asbestos

- Asbestos is a mineral fiber found in nature which is normally used for insulation.
- Asbestos has been used in the past for fireproofing and soundproofing in ceiling and floor tiles.
- Asbestos is still used for clutch discs and brake linings in automobiles.
- Asbestos fibers are extremely small and become airborne when separated from parent material.
- Asbestos fibers can be inhaled into the lungs or ingested in food or water.
- Asbestos fibers are known to cause cancer.

Figure 8



Air Pollution in the House

Objective 8

Clean Air Act Amendments of 1990

The Clean Air Act Amendments brought significant and wide-ranging changes dealing with all kinds of air pollution. Large or small, mobile or stationary sources were targeted. Routine and toxic emissions, ranging from power plants to consumer products were affected.

Note: The Clean Air Act Amendments targeted several specific areas:

- Acid Rain
- Urban Smog
- Automobile Emissions
- Toxic Air Pollutants
- Depletion of the Ozone Layer

Objective 9

Methods of controlling motor vehicle emissions

- a. Reduce the escape of hydrocarbons from fuel systems.
- b. Keep engines tuned.
- c. Maintain emission control systems and catalytic converters.
- d. Use lead-free gasoline.
- e. Reduce sulfur compounds during refining of diesel fuel.
- f. Use ethanol (grain alcohol) as a fuel.

Note: Ethanol is a grain and biomass-based product.

- g. Use methanol (wood alcohol) as a fuel.

Note: Methanol is a petroleum-based product.

Objective 10

Types of pollution control measures that the government may impose on polluters to achieve compliance with environmental regulations

Note: The EPA has established National Ambient Air Quality Standards (NAAQS). These standards are designed to set limits on the amount of pollution allowed in the air and to force those who pollute the air to stop.

Key term:

- **Point source air pollution**—A specific place where air pollution originates
 - a. **Point source air pollution** controls—Impose standards on the emissions coming from a facility without regard to the cost of achieving the standard or the mixture of that discharge with other point-source discharges in the local environment.

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	b. Pollution allowances—Concentrate on the level of pollution in the local area requiring pollution reduction measures when the air is out of compliance. Note: The goal of this method is to use market incentives of cost control, allowing sources to make their own decisions as to comply with emission limits.
Objective 11	Methods of controlling air pollution from industry and electrical power generating plants a. Install equipment (scrubbers) to remove air contaminants from stack exhaust. b. Remove pollutants from fuel source such as sulfur from coal. c. Use technologies which reduce contaminants in exhaust emissions. d. Use coal with low sulfur content. e. Convert operations to fuels which produce less air pollutants such as natural gas, solar, wind, and nuclear.
Objective 12	Air quality trends in the United States (from 1970 to present) a. Particulates (Total Suspended Particulates—TSP) • Particulate levels have decreased. • Decrease in particulate levels is due to installation of pollution control devices on sources of particulates. • Particulate levels in the atmosphere can be reduced further by improved pollution control devices. b. Sulfur dioxide (SO₂) • Sulfur dioxide levels have decreased. • Decrease in sulfur dioxide is primarily due to pollution control devices installed on coal-fired power plants. • Sulfur dioxide levels could decrease further if improved pollution control devices are used. • Since 1994 over-the-road diesel fuel has been mandated to be sulfur free and dyed to ensure proper identification. c. Carbon monoxide (CO) • Carbon monoxide levels have decreased.

Information Sheet

- Decrease in atmospheric carbon monoxide is due largely to emission control devices on motor vehicles.

d. Ozone (O_3)

- Ozone levels have decreased.
- Decrease in ozone is due to emission control devices on automobiles and improved emission control of electric power generators and industries.
- Atmospheric ozone should continue to decline as control technology is improved.

Note: It should be understood that ozone is a pollutant in the air we breathe, but the ozone shield high above the earth protects us from harmful radiation. Also, some of the pollutant ozone is indeed carried by wind into the stratosphere where it joins the ozone shield.

e. Nitrogen dioxide (NO_2)

- Nitrogen dioxide levels have increased.
- Although major strides have been made in reducing NO_2 emissions from auto exhaust, the substantial increase in miles driven and traffic volume has offset reductions.

f. Lead (Pb)

- Lead in the atmosphere has decreased.
- The decrease in atmospheric lead is primarily due to removing lead from gasoline.
- Atmospheric lead is expected to continue to decline, but at a slower rate than it has over the past 20 years.

Objective 13

Global considerations in air resource management

- a. Air pollutants generated in one country may affect neighboring countries or the world.
 - Sulfur dioxide emissions from coal power plants in the United States have caused acid rain in Canada.
 - Burning of rain forests in South America may contribute to the greenhouse effect, causing world climate change.
 - Synthetic chemicals from global industries may deplete the ozone shield causing serious health problems worldwide.
- b. International cooperation will be needed to solve air pollution problems.

Information Sheet

Objective 14

Factors that cause weather

Key term:

- **Weather**—The current condition of the atmosphere including temperature, wind, moisture, and atmospheric pressure.
 - a. Air masses and fronts
 - b. Clouds and moisture
 - c. Precipitation and humidity
 - d. Wind

Objective 15

Career opportunities in air resource management

- a. Meteorology
- b. Environmental science
- c. Air quality management
- d. Physics
- e. Air quality engineering
- f. Physical, chemical, and engineering technicians

Note: Salaries of individual careers will depend on level of education and years of experience.

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Student Supplement 1—Allowance Trading System

(Adapted from Clean Air Act Amendments of 1990)

There are many different ways that air pollution laws are enforced. The pollution allowance system can reduce pollution by using incentives and market forces to encourage pollution reduction.

Under an allowance trading system, large stationary sources of air pollution, such as power plants, receive a certain number of "pollution allowances." Pollution allowances are given for a specified period of time, based on local clean air standards and allocated to the sources according to their historic fuel consumption and a specified emissions rate source. Allowances are in units of pollutant emitted, so a source will use up its allowances as it emits. The key to the system is that these allowances may be traded between sources. At the end of a period, each source must have enough allowances to balance its emissions for that period; otherwise a penalty on each excess unit of pollution is imposed. The goal of the system is to use market incentives of cost control to allow sources to make their own decisions as to how they will comply with emission limits.

Example: An electric utility, Metropolis Power and Light (MP&L) wants to install a certain pollution reduction technology at one of its electricity generation plants that will cost \$100,000. Without an allowance system, MP&L may not have an economic rationale for the project. Under an allowance trading system, MP&L would save four allowances if it installs the clean air equipment and reduces its emissions of pollution. MP&L can sell the allowances in the pollution allowance market and recover part or all of the money it spent on the equipment, or even receive compensation above the amount spent.

Another utility, Old World Gas and Electric (OWG&E) does not implement pollution reduction measures. During the year, OWG&E has used up all its allowances and is going to pay \$250,000 in fines for emissions in excess of its allowances. OWG&E estimates that it is four allowances short for the period and is willing to pay MP&L up to \$250,000 for four allowances. Therefore, MP&L, by implementing pollution reduction measures at a cost of \$100,000, is rewarded the difference between that cost and the market value of the allowances it saves. In this example, $\$250,000 - \$100,000 = \$150,000$ to MP&L.

**Air Masses
and Fronts****Student Supplement 2—Understanding the Weather**

(Adapted from *Working With Weather, Successful Farming*, 1994)

Understanding the weather has been a challenge for humans throughout history, and even with today's sophisticated computers and satellite monitoring systems, truly accurate forecasts of climatological activities remain rare.

Although there is a wide variety of factors that cause weather, this supplement will deal only with the "weather makers" most people see and hear about every day.

The earth's atmosphere is not merely a quiet layer of breathable air from sea level to the upper reaches of the stratosphere. In actuality the atmosphere is a pitching, churning "sea" of air kept turbulent by large masses of air called high pressure systems. A high pressure system is literally a mound of air which exerts pressure on the earth and its inhabitants below.

The "weight" of a high pressure system, and the air around it, can be measured with an instrument called a barometer. As a high pressure system approaches, the barometer responds with "higher" readings. Barometric readings are quoted in terms of "inches of mercury," relating to the construction of many barometers which measure air pressure by its effect on a column of mercury trapped in a glass tube. More common barometers (those which look like auto or aircraft instruments) are called "aneroid barometers" and use a hermetically sealed bellows with which to measure air pressure.

As high pressure systems move about, driven by the earth's surface temperatures and upper level winds created at their border with lower pressure areas, they become the driving force behind one of the most common terms used by weather forecasters—the front.

While air masses share the same background, they can be either warm or cold depending upon where they were created.

Cold air masses that affect North America often develop over Alaska and northwest Canada and usually drift south and east along the eastern slopes of the Rocky Mountains. This type of air mass has a tendency to be dry, unless it slips out over the Pacific Ocean where it picks up moisture before drifting eastward across the Americas. As this cold air mass travels south over warmer terrain, it tends to heat up which increases its ability to hold moisture. The tiny particles of moisture (thousands of times smaller than a rain drop) divide into even smaller particles as the air around them warms. This, plus the fact that cold air masses contain less moisture, is why these "systems" are less likely to cause precipitation.

Warm air masses, however, generally develop off the eastern coast of Florida and move across the Gulf of Mexico, soaking up moisture, before they push northward onto the North American Continent and drift eastward. When this occurs the warm air mass is moving over terrain that is colder than itself. This causes the moisture in the mass to condense, increasing the chances of it producing precipitation.

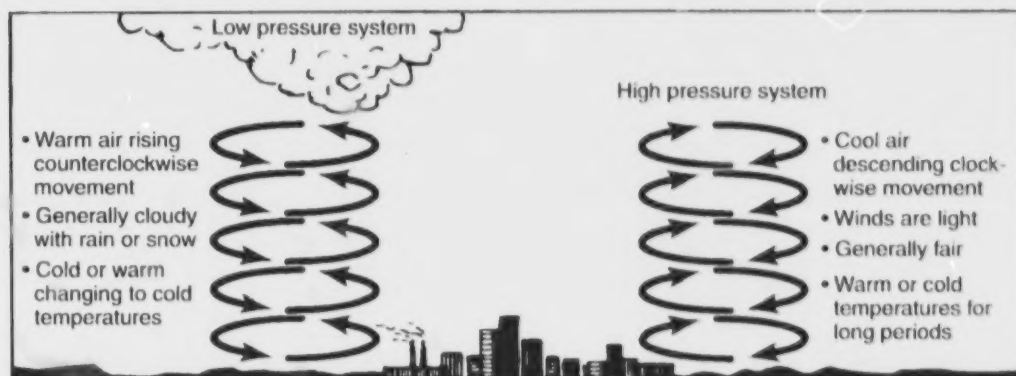
Student Supplement 2

As long as these two systems move along and never meet, the weather picture is quite boring. When they collide, however, unstable conditions occur.

Cold and warm air, like oil and water, don't readily mix. When they meet they push against one another in an effort to move ahead. Often the cold air mass, which contains more weight (literally the weight of the air piled up in the mass) or internal pressure, wins by ducking under the edge of the warm air which is then pushed upward.

Because both cold and warm air masses are high pressure systems, they rotate in a clockwise direction when viewed from the top. (In the southern hemisphere, however, they operate counterclockwise.) When two highs, both spinning in the same direction, approach one another they create a vacuum-like effect between them. This spawns a low pressure system or "cell." The air in a low-pressure cell is spun in the opposite direction—counterclockwise (in the Northern hemisphere) by the trailing edge of one high and the leading edge of the other.

Figure 1



You recall in a high pressure system the water droplets are forced downward and are dispersed. The opposite is true in a low-pressure cell. Here it rises and cools. This causes the tiny particles of moisture to condense and eventually grow large enough to overcome the force of internal winds and gravity and fall to earth. So, "lows" on the weather map are depicted on the weather map as more likely to produce precipitation.

All the pushing and shoving between air masses, and the low-pressure cells they create, also spawns a weather boundary called a front. As you might guess, cold and warm air masses create cold or warm fronts.

Cold fronts are represented on a weather map as a curved line with arrowhead-shaped marks on them.

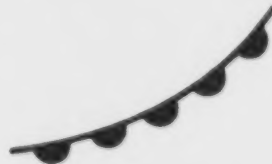
Figure 2



The arrowheads point in the direction the front is moving. Cold fronts usually move at speeds of 20 to 30 miles per hour. When accompanied by moist air and certain other conditions, cold fronts can cause brief but fairly violent storms. However, cold fronts tend to carry less moisture than warm fronts so they are less likely to drop a great deal of precipitation. In the Northern hemisphere if a cold front is bringing rain or snow, it will be preceded by clouds and increased southerly wind velocity.

Warm fronts are shown on weather maps by lines with rounded, bump-like marks on them, also pointing in the direction of their movement.

Figure 3



Warm fronts usually don't have as much curve to them as their colder counterparts on the weather map. Also they are slowpokes, normally moving about 10 to 15 mph.

Storms growing out of warm fronts tend to be less violent than those from cold fronts. But warm fronts usually pack far more precipitation. That's because the warm air behind them likely formed over the ocean where it absorbed much moisture before moving landward. As warm fronts cool while crossing land they become less stable.

Student Supplement 2

Clouds and Moisture

One of the major problems with weather predictions is that fronts, either warm or cold, are anything but dependable. At times they move along at a steady, typical speed only to suddenly shift directions and speeds. At other times they opt to stall out and remain in one place for hours or days. When this happens the movement is labeled a stationary front, represented on a weather map by a mixture of arrows and bumps on a line.

Figure 4



Although we cannot see the dividing lines of warm or cold fronts, the presence of clouds gives us a very accurate picture of the location of these air masses.

If you have ever walked in fog, you have walked in a cloud. Fog is nothing more than a cloud on the ground.

Clouds are created from masses of tiny water, snow, or ice crystals suspended in the air. Still the amount of moisture in even a giant summer thunderhead is small. For example, all the water in a towering thunderhead would fill only two or three swimming pools. And one of those fluffy white summer afternoon clouds holds less moisture than a livestock water tank and weighs about as much as a human.

Clouds are light because they are made up of water vapor. Actually we are surrounded by moisture vapor—suspended water one cannot see until it rises in the sky to cool and condense or in your breath on a cold winter day.

As it rises, air expands and cools. And as it expands, the water in the air condenses into minuscule droplets one millionth the size of a rain drop. When enough droplets gather, they form a cloud. The point in the sky where moisture condenses is called the "condensation level" and is easily seen as the flat bottom of a puffy cloud.

Depending upon conditions, nature can form three basic types of clouds—cirrus, cumulus, and stratus. Let's describe them, and their variations from highest to lowest.

- **Cirrus**—These clouds wander at the rooftop of the sky. They are thin, wispy, and feathery formations made up entirely of ice crystals, usually found from 25,000 feet above the earth to more than 10 miles up. Cirrus clouds, driven by upper level winds, generally move around 65 to 75 mph, but appear much slower because of their extreme altitude.

- **Cirrostratus**—These clouds form from 20,000 to 25,000 feet above the earth and look like a fine, whitish veil that extends over all or part of the sky. The sun is easily visible through cirrostratus formations which often produce halos around the sun or moon.
- **Altostratus**—These clouds are formless, grayish groups of water droplets that cover part or all of the sky in a great sheet. They often appear fibrous or stripped and do not form a halo around the sun or moon. In the daytime, however, one can always see the sun through altostratus clouds.
- **Alto cumulus**—These clouds are patches or layers of puffy and rippled clouds that are gray or white. The sun shining through alto cumulus clouds can create a corona or disk and is pale blue or yellow in the middle and reddish on the outside. Neither altostratus or alto cumulus clouds drop precipitation that reaches the ground.

Rain-producing clouds are found floating from 6,500 feet above the earth to the surface. They include:

- **Stratus**—These formations float at about 6,500 feet or less and are thick, gray, dull sheets covering the entire sky—completely blocking the sun. Usually stratus clouds produce little more than a fine drizzle.
- **Nimbostratus**—These clouds are dark gray with moisture and completely blanket the sky. They have little structure such as puffs or ripples and can produce rain or snow that lasts for a day or more. When the wind is strong enough, nimbostratus sheets are often teamed up with low lying individual clouds called "scud" or "fractostratus" clouds.
- **Stratocumulus**—These clouds cover the sky but are irregular masses of moisture spread out in a bumpy or rolling layer. Again, these thick clouds block out the sun, but rarely produce rain unless they mass together to form a nimbostratus blanket.
- **Cumulus**—These clouds and the cumulonimbus are the only two cloud types that form vertically. Both appear predominately in warmer weather. Cumulus clouds are the most common type of cloud seen on summer days. White and puffy, these clouds show a sharp border above and below and are often torn by strong winds with detached parts constantly changing shapes. Cumulus clouds are formed by condensation of water vapor in a rising column of air. The flat base of a cumulus cloud marks the level where the condensation temperature is reached. Cumulus clouds rarely produce rain unless they gather together.
- **Cumulonimbus**—These are the towering monsters of spring, summer, and fall known as thunderheads. The flat bottom of a cumulonimbus can almost touch the ground while their tops — which often form into anvil shapes as they mature—can reach as high as 75,000 feet. Cumulonimbus clouds are the most violent, producing lightning, thunder, hail, strong straight winds, and tornadoes.

Student Supplement 2

Precipitation and Humidity

Any of these cloud formations can exist alone or in combination with others. They also can change from one type to another when variations in temperatures or moisture occur. And, changing clouds indicate the weather is also about to change.

When the tiny droplets of water in clouds—particularly those found closer to the earth—congregate closely, precipitation is born. The most common form of precipitation is rain.

There are three ways these droplets can combine and drop to earth. When air in a cloud becomes turbulent, movement of the droplets increases. Smaller droplets bump into larger, slower droplets until a drop of sufficient size is formed and pulled down by gravity.

At higher altitudes, some of these droplets freeze into ice crystals. Other droplets evaporate and adhere to these crystals until the crystals become heavy enough to fall. If temperatures are warm, these crystals melt and fall as rain. This is believed to be the most prevalent way in which rain drops form.

Or, during a thunderstorm, discharges of lightning emit oxides of nitrogen which readily absorb moisture forming raindrops large enough to fall to the ground.

Rain isn't the only moisture that falls from the sky, however.

When the air is supersaturated with water and is below the freezing point, snowflakes can form. But instead of moisture bumping together, as it does for raindrops, flakes are created around microscopic particles of dust, sand, or ash found in the air. Ideal cloud temperatures for snowflake formation are from 10 degrees F. to -4 degrees F.

Sleet or ice pellets occur when raindrops form at warmer temperatures aloft and freeze as they fall through cold surface temperatures.

Hail is created when raindrops are frozen at high altitudes and then bounced around, adhering to others, in a thunderhead until they become heavy enough to fall.

Dew and frost occur when moisture condenses on the ground and on nearby objects. This happens because these surfaces are colder than the moisture in the air. A good example of dew is the moisture that forms on a cold glass of iced tea on a summer day.

The difference between these two forms of precipitation is the moisture in frost changes directly to crystals without first condensing into water drops.

Anyone who has suffered through a still, sultry, summer night without air conditioning is aware we can feel moisture that is not falling out of the sky. This type of water vapor is humidity.

Wind

The relative humidity so frequently mentioned by TV weather forecasters is the percent of moisture air can hold at a particular temperature. When air with a given amount of vapor cools, its relative humidity increases. When the air is warmed, its relative humidity drops. Air can be so loaded with water vapor that it becomes saturated. When this happens the air's relative humidity is 100 percent and it has reached the dew point—the point at which the vapor condenses and becomes some form of precipitation.

All of the heating and cooling that occurs with weather creates the refreshing breath of air on a summer day or the icy, bone-chilling blast in the winter—the wind.

Wind exists because of the action of heated air rising into the sky and cooler air rushing in to replace it. When this occurs on a massive scale, wind is created. Because it is driven by heating, winds tend to "die down" at sunset.

Because water and land tend to heat and cool at different rates, the air circulation above them differs. This adds to the variability of winds, as do other factors.

The effects of warm air being replaced by colder air extend from the polar regions to the equator. If the earth were not rotating, the winds created by this activity—called convection currents would be from north to south in the Northern hemisphere. However, since the earth is spinning to the east at about 700 mph at the 45th parallel (the Chicago area) the convection currents end up flowing primarily from west to east.

High- and low-pressure air masses also produce winds. Highs tend to push air toward lows. The closer the masses are to one another, the stronger the winds.

The strongest winds occur at altitudes of about 35,000 ft., where corridors of wind known as jet streams form. These winds run from 100 to 200 mph in the high altitudes where there is little resistance to their flow. Their paths move generally west to east but develop curves due to pressure differences of air masses along their routes.

Closer to earth, wind velocity is slowed by friction caused by mountains, hills, buildings, and vegetation. This friction tends to heat the air, causing it to rise—creating even more wind.

Student Supplement 3—Forecasting the Weather

(Adapted from *Working With Weather, Successful Farming*, 1994)

Forecasting the weather is an "iffy" proposition even if you have a degree in meteorology and are equipped with the latest electronic equipment, banks of computers, and access to satellite remote sensing. Still, with knowledge of the weather makers explained in Student Supplement 2 and a few of the following basic weather tools, it is surprising how accurate one can be by just observing cloud formations, wind direction, and barometric pressure trends.

In fact, this method was used in one elementary school as a 6th grade class science project. The results, the 6th graders were about 85 percent accurate in their 12-48 hour forecasts!

Tools You Need

Note: The following specialized weather monitoring tools can be obtained at hardware stores or through a number of specialty catalogs.

- **Barometer**—A good quality barometer is an absolute must to formulate weather forecasts. Look for an aneroid barometer, because they are more compact and much more accurate than the mercury column variety. Don't be misled or impressed by barometers which sport such words as "Fair," "Stormy," or "Changing Weather" on the face of their dials. These phrases are generally meaningless. What is more important are the pressure readings listed on the instrument's face, and the ability to set the barometer for one's community elevation above sea level.
- **Thermometer**—Most simple mercury thermometers will do a good job. However, a "maximum/minimum" thermometer that uses two tubes to register how high and low the temperature traveled during a period of time is a greater value for keeping weather records.
- **Rain gauge**—Any rain gauge, provided it is emptied on a regular basis and kept clean, is adequate for normal use. More expensive models have greater capacity and many times are calibrated for more accuracy. For snow, just use a ruler stuck in a flat area of snowfall not affected by the wind.
- **Wind vane**—A moist finger stuck in the air provides a quick way to determine wind direction, but it helps to invest in a vane for better accuracy. Also consider an anemometer to measure wind velocity. Both instruments (many times built together for common mounting) should be mounted in an area where wind flows are not affected by buildings or trees.

Finally, it helps to record your observations and measurements for future reference. A weather log can be found in Assignment Sheet 3.

Clouds

While weather instruments provide good insight to changing conditions, personal observation of outdoor conditions is surprisingly accurate also.

By watching clouds, one gets the first glimpse of change.

Student Supplement 3

Reading Pressure and Wind

Some Forecasting Rule of Thumb

Cirrus clouds—the highest of all formations—foretell changing weather a day or days before it occurs. Simple cirrus clouds usually mean fair weather in store, but if they tend to thicken and the wind is out of the east or south in summer or the south in winter, they can foretell rain or snow. Cirrostratus clouds predict generally fair weather, especially if they break into cirrocumulus clouds. But, cirrocumulus clouds that begin to thicken and fall lower to the earth indicate the change of rain.

Alto clouds—The advent of altocumulus formations can predict rain, especially if the circle (corona) around the sun decreases and if the winds are from the north or south in summer. However, warmer weather lies ahead in winter if the winds are from the north, east, and south. Altostratus clouds often precede storms if the clouds darken toward the west.

Stratus clouds, by themselves indicate fair weather ahead, especially if they get smaller and break apart. However stratocumulus clouds are a sure sign the weather is changing, particularly if winds are from the north or south in the summer; or north, east, and south in the winter. Finally, nimbostratus clouds indicate a long period of rain that will only turn clear with wind movement in summer.

Cumulus clouds, those puffy summer afternoon clouds, are a sure sign of fair weather—unless they start gathering together. If this occurs on a massive scale, such as with vertical building of a cumulonimbus cloud, then brace for the worst as the weather is changing for the worse.

Clouds moving faster across the sky point to a change in wind velocity and in barometric pressure. Both situations can signal an approaching storm. Also, when several layers of clouds are moving in different directions at different altitudes storms could be imminent.

Once you have a good handle on reading cloud formations, fine-tune those predictions by combining your observations with barometric pressure readings and wind speed and direction. All three elements, used in conjunction with a current weather map and area forecast, creates amazingly accurate predictions for a 12 to 48 hour period.

To bring pressure readings and wind directions together for forecasting, see the forecast guide at the end of this supplement.

In his book, *The Basic Essentials of Weather Forecasting*, Michael Hodgson adapted the following material gathered by the National Weather Service for average conditions within the Continental U.S.

When winds are from the northwest and the weather has been clear, expect 24 hours of continued clear weather if your barometer is steady or rising. If it has been raining and you read a rise in barometric pressure, weather should clear in several hours. In all of these cases expect lower temperatures.

If your barometer shows a drop in pressure, expect it to remain clear for 12 to 24 hours if it has been clear, or expect the weather to change if it has been stormy.

When winds are from the southwest and weather has been clear, anticipate continued fair weather for 12 to 24 hours if the barometer shows a rise in pressure. If it has been stormy and you read a rise in pressure, then the storm should pass within six hours.

When weather has been clear and winds are from the southeast, plan on continued fair weather if the barometer is rising. If the weather has been stormy, anticipate clearing weather soon after the barometer begins to show a rise in air pressure.

When winds are in the northeast and the weather is clear, expect continued fair, but cool weather if the barometer shows a rise in pressure. If the weather has been stormy, expect skies to clear and temperatures to drop.

Finally, there are a number of general signs indicating the advent of either fair or foul weather that you can use as a reference in the field.

Fair weather signs:

- Dew or frost in the night or early morning
- Morning fog that burns off by noon
- A red sunset in a blue sky (Red at night, sailors delight)
- A brilliant moon on a clear day
- A clear night sky with light winds

Foul weather signs:

- Any rapid rise or drop in temperature
- A ring around the moon, especially if the barometer is dropping
- A rusty, red hue around the sunrise (Red in the morning, sailors take warning)
- The rapid approach of a warm or cold front as indicated by a weather forecast

Student Supplement 3

Barometric Pressure and Wind Forecast Chart

Barometer Reading (corrected)	Barometer Action	Wind Direction From the:			
		Northwest	Southwest	Southeast	Northeast
30.20 or Higher	Rising	Continued fair for 24 hours Lower temperatures	Continued fair for 12 hours	Fair weather	Clear and cool
	Steady	Continued fair for 48 hours No decided change in temperature	Continued fair for 12 hours No decided change in temperature	Rain within 24 to 48 hours	Continued fair Lower temperatures
	Falling	Continued fair for 24 hours Slowly rising temperatures	Fair for 6 to 12 hours Rising temperatures	Rain within 2 hours Wind increasing in force, rising temperatures	Rain within 24 to 48 hours
30.20 to 29.80	Rising	Fair for 48 hours Lower temperatures	Fair for 48 hours Lower temperatures	Fair	Clear with colder weather
	Steady	Continued rainy conditions	Fair for 12 hours No decided change in temperatures	Rain within 12 to 18 hours	No change
	Falling	Fair for 12 to 24 hours No decided change in temperature	Rain imminent	Rain within 6 to 12 hours Wind increasing in force, rising temperatures	Rain within 12 hours
29.80 or Lower	Rising	Clearing within a few hours Lower temperatures	Clearing within 6 hours	Clearing weather	Clearing and cooler
	Steady	Continued threatening weather Lower temperatures	Continued stormy weather	Continued rain or no change	Rainy weather Clearing 12 to 24 hours
	Falling	Changing weather	Increasing rain Clearing within 12 hours	Severe storm imminent Clearing within 24 hours	Heavy rain Severe northeast gale, cooler temperatures

To use this weather chart you need to obtain a barometer reading corrected to sea level, determine the action of the barometer (rising, falling, steady), and gauge the average wind direction (the chart is set for an average wind velocity of 10 miles per hour). For example, take a barometer reading that measures between 30.20 to 29.80. If that reading is rising and the wind is coming from the northwest, you can assume that it will be fair for the next 48 hours with temperatures dropping. Higher wind speeds and rapidly rising or falling barometer readings often indicate an immediate change in weather. Fine-tune this prediction with observations of cloud activity and official forecasts to obtain an even more accurate picture of weather over your vicinity.

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Unit Contents

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	* Assignment Sheets are located in the Student Workbook.		

Objective Sheet**Unit
Objective**

After completing this unit, the student should be able to compare various energy resources, research the use of agricultural products as alternative energy resources, and perform an energy audit on a home. The student should demonstrate these competencies by completing the assignment sheets and by scoring a minimum of 85 percent on the written test.

**Specific
Objectives**

After completing this unit, the student should be able to:

1. Match terms related to energy resources with their definitions.
2. Match terms used to describe energy conversion with their descriptions.
3. Classify energy resources as renewable or nonrenewable.
4. Complete statements concerning coal energy resources.
5. Select true statements concerning oil energy resources.
6. Select true statements concerning natural gas energy resources.
7. Complete statements concerning nuclear energy resources.
8. Select true statements concerning hydropower energy resources.
9. Complete statements concerning biomass energy resources.
10. Select true statements concerning solar energy resources.
11. Complete statements concerning wind energy resources.
12. Select true statements concerning geothermal energy resources.
13. Match U.S. energy resources with their correct reserve supplies.
14. Draw a pie chart showing the uses of oil resources in the United States.
15. Select from a list the goals of energy conservation.
16. Select true statements concerning ways to conserve energy.
17. List career opportunities related to energy resources.
18. Discuss the effects of our dependence on imported oil.
(Assignment Sheet 1)
19. Compare electricity production from coal and nuclear fuel.
(Assignment Sheet 2)

Objective Sheet

20. Give your opinion on using agricultural products as alternative energy resources. (Assignment Sheet 3)
21. Perform an energy audit of your home. (Assignment Sheet 4)
22. Explore the various factions and viewpoints involved with the use of renewable and nonrenewable resources. (Assignment Sheet 5)

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Information Sheet

Key terms:

- **Energy**—The capacity to do work or the ability to make things move
- **Fossil fuels**—Hydrocarbon compounds derived from the remains of organisms (plants and animals) buried millions of years ago

Introduction

What happens when the electricity goes off? The lights, televisions, radios, computers, and other devices around you stop. The silence allows you to hear things you have never heard before. We use energy for so many things! When it is no longer available, we find our lives so different. If people are smart, they will not run out of energy. They will use it more efficiently and in some cases find new sources of energy.

Energy is the capacity to do work or the ability to make things move. It comes in different forms like heat, light, sound, mechanical and chemical. Without energy we would not have television, computers or cars. We would cook our dinners over a fire and collect water from a river. We use energy to make our lives easier.

Today, the major sources of energy in the United States are: oil (40%), natural gas (25%), coal (22%), nuclear (8%), and renewable (4%). As you may have noticed most of the energy we use today comes from **fossil fuels** — oil, natural gas, and coal. We sometimes use uranium for nuclear energy, but it has limited use. These are all fuels that are being consumed more rapidly than they are being replaced. That means that someday we could run out of these fuels.

Renewable energy comes from energy sources that are constantly being replaced and are usually less polluting than energy from fossil fuels. Examples of renewable energy include solar, wind, geothermal, biomass, and hydro.

Solar energy comes from the sun. It is used to heat homes and water in more than 200,000 homes in the United States today. It can also be made directly into electricity using photovoltaic (PV) cells. PV cells make electricity without moving, making noise, or polluting. We most often see these in calculators and watches.

Wind is used to generate electricity. We now have wind farms where large groups of wind turbines are connected to electric utility lines and provide electricity to many people.

Biomass energy comes from plants and trees. Wood is the largest source of biomass energy. We also use corn, soybeans, sugarcane wastes, and other farming byproducts to produce biomass energy. Energy produced by biomass could someday supply much of the fuel for our cars, trucks, buses, airplanes, and trains. This is very important because nearly one-third of our nation's energy is now used for transportation.

There are other sources of renewable energy including water and geothermal.

Information Sheet

Objective 1

One day much of the energy you use may come from renewable sources. As scientists find better ways to develop renewable energy, we may no longer have to depend upon fossil fuel energy. This will help us keep our environment cleaner

Terms and definitions

Barrel (bbl)	Energy reserves
Biomass	Energy resources
Combustion	Fossil fuels
Energy	Nonrenewable energy
Energy conservation	Renewable energy

Objective 2

Terms used to describe energy conversion

- a. Kinetic energy—Energy of an object or body due to its motion; the ability to move an object a vertical distance

Note: People use energy to move things from one place to another. They use mechanical and electronic devices to create movement.

Examples: Moving automobiles, high-speed electrons in a computer screen

- b. Potential energy—Energy due to the place or position of something; it is not moving but could do so under the right conditions.

Examples: Materials used as fuel (until the potential energy is released); a rock resting on a cliff (it could suddenly fall)

- c. Transformation of energy—Energy is constantly changing from potential energy to kinetic energy and back to potential

Note: This is sometimes called energy conversion.

Examples:

- Energy may change to heat. In an internal combustion engine, burning fuel creates heat. Heat cause gases to expand forcing the piston to move inside the cylinder. When this happens, energy is converted to mechanical power.
- A car may use potential energy stored as fuel to go up a mountain. At the top of the mountain, the fuel tank contains less fuel. However, the car has the potential of coasting down the mountain without using fuel as it moves.
- Is the energy lost or does it change form?

Objective 3

Classifications of energy sources

Key terms:

- **Nonrenewable energy**—Resources which cannot be replaced once they are used
- **Renewable energy**—Resources that can be replaced by natural regeneration or human efforts after they are used
- **Energy resources**—A measure of national wealth by the production of usable power such as heat and electricity

a. **Nonrenewable energy resources**

Figure 1

Coal

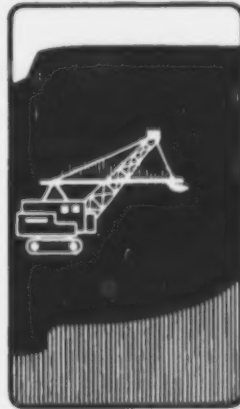


Figure 2

Natural gas



Figure 3

Oil



Figure 4

Uranium



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Information Sheet

b. Renewable energy resources

Figure 5

Hydropower

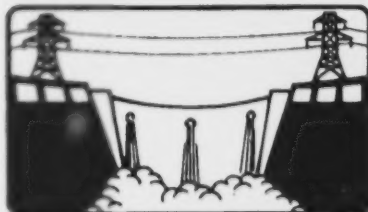


Figure 6

Geothermal



Figure 7

Wind



Figure 8

Solar

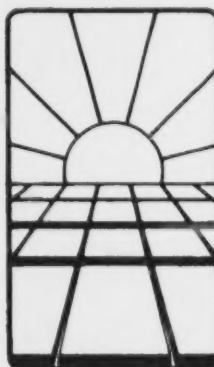


Figure 9

Biomass



Objective 4

Coal energy resources

Key term:

- **Combustion**—The chemical process of burning which releases heat, light, and chemical by-products

Note: Each time a fuel is burned in a combustion process, some type of pollutant is released into the air.

- a. Coal is a dark brown to black, flammable, solid fossil fuel.
- b. Coal is used for heating, electric generation, and as a raw material for many manufactured materials.
- c. The cost of producing electricity from coal is 10% higher than electricity produced in nuclear power plants.

- d. Environmental considerations of coal use
 - Rehabilitation of surface areas disturbed by strip mining.
 - Transportation of coal from mine to user facility.
 - Air pollutants causing acid rain, greenhouse effect, and smog.
 - Disposal of 10% of coal as ash following **combustion**.
 - Thermal pollution from cooling system.
- e. Future of coal as an energy resource
 - The United States has an abundance of coal to use.
 - The use of coal will reduce the amount of imported oil needed.
- f. Future needs associated with coal use
 - Air pollutants must be reduced from coal combustion.
 - Thermal pollution must be reduced.

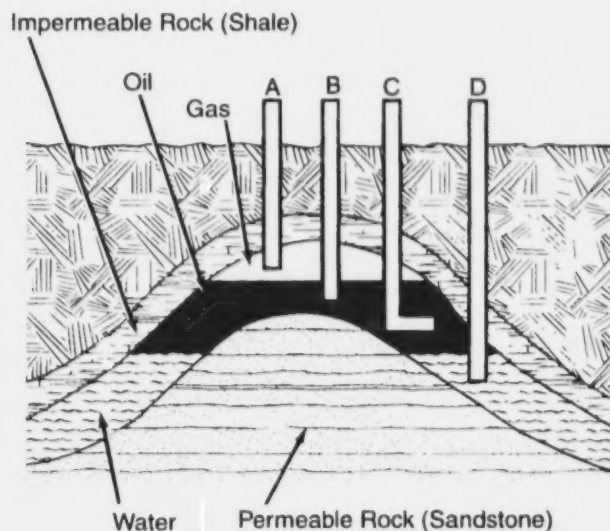
Information Sheet

Objective 5

Oil energy resources

- a. Oil (petroleum) is a natural, yellow-to-black, flammable, thick liquid fossil fuel.
- b. Oil is produced by drilling a well to the resource formations.

Figure 10



Well A — Gas Well

Well B — Conventional Oil Well

Well C — Horizontally Drilled Oil Well (increases production)

Well D — Water Well

Note: Layers of rock trap oil and natural gas

- If the oil bearing formation is under pressure, the oil will flow to the surface.

Note: Formation pressure is usually attributable to large quantities of natural gas trapped above the oil deposits.

- Pumps are placed in the wells that do not flow.

- c. Oil is used for heating, transportation fuel, and as a raw material that is refined into gasoline, naphtha, kerosene, lubricating oils, paraffin wax, asphalt, and a wide variety of derivative (petrochemical) products.
- d. Oil is relatively economical to use. When used for heat, it compares favorably with coal.

- e. Environmental considerations of oil use
 - Producing and abandoned wells can pollute ground water.
 - Transporting oil through pipelines and on ships poses an environmental risk.
 - Air pollution from oil use is a major cause of smog, acid rain, and the greenhouse effect.
- f. Future of oil use
 - Oil supplies in the U.S. are being depleted.
 - The U.S. imports approximately 50% of the oil it uses. (Amount varies.)
- g. Future needs associated with oil use.
 - Alternate energy sources must be developed to reduce the dependence on foreign supplies.
 - Conservation practices must be used to conserve oil supplies.

Objective 6

Natural gas energy resources

- a. Natural gas is a mixture of hydrocarbon gases, principally methane, also ethane, butane, and propane.
- b. Natural gas is generally found in the presence of oil in subsurface formations.
- c. Gas is recovered by drilling to the gas bearing formation. Most natural gas formations are pressurized, forcing the gas to the surface.
- d. Natural gas must be cleaned with an extraction unit to remove impurities, such as water, sulfur, and dirt. At the processing plant butane, propane, and gasoline are removed from the natural gas. The finished gas is then moved into the transportation pipeline.
- e. Natural gas is used for heating, cooking, transportation (as compressed natural gas) and in the manufacture of organic compounds and products, such as fertilizers.
- f. Natural gas may be stored in a liquid state (-268°F or -168°C).

Note: This is known as liquified natural gas (LNG)
- g. Natural gas is an economical source of energy which competes favorably with coal.

Information Sheet

- h. Environmental problems associated with gas combustion are minimal as compared with coal, oil, and nuclear fuels.

- Natural gas seldom needs returning prior to use.
- By-products of gas combustion add to the greenhouse effect.

- i. Limitations of natural gas use

- U.S. supplies are limited.
- Supplying the gas when customers need it
- Gas must be transported by pipeline, limiting its use.

Note: When natural gas is put under pressure, it can be liquified which makes it easier to transport.

- j. Future needs associated with natural gas use

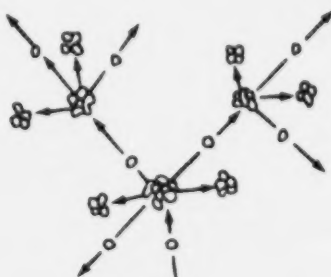
- Gas supplies must be conserved.
- Alternate energy sources must be developed.

Objective 7

Nuclear energy resources

- a. Nuclear energy is produced from uranium which gives off energy when uranium atoms are split.

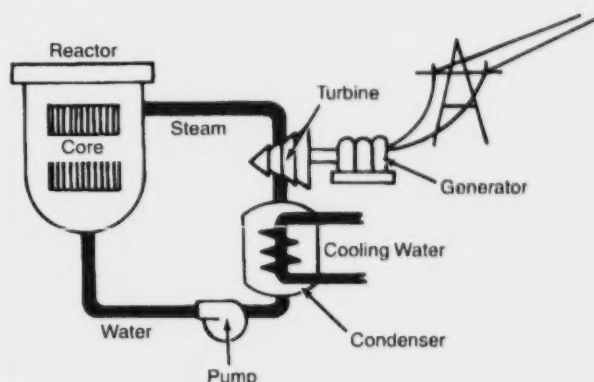
Figure 11



- b. Uranium is a naturally-occurring element.
- c. While traces of uranium are common in soils around us, commercial quantities are found in Colorado, Wyoming, and along the Texas coast.
- d. Uranium is found in pore spaces in sandstone where it was deposited by ground water movement.
- e. Uranium is mined by the same methods as coal and other minerals, either by shaft mines or open-pit methods.

- f. Uranium is primarily used to power nuclear reactors which generate electricity.

Figure 12



- g. Nuclear energy created by uranium can produce energy 10% cheaper than coal fired plants.

Note: Actual energy production is cheaper than coal-fired plant operation, but startup costs of a nuclear powered plant are much higher because of regulations, fees, and litigation with the environmental groups opposing nuclear power. No new nuclear plants have been brought on line since the 1970s.

- h. Environmental problems associated with nuclear energy.

- Fear of a reactor accident which would release radioactivity to the surrounding area.
- Disposal of radioactive waste following use because it is deadly and because it lasts so long.

Note: The half life of radium is 1,580 years which means the time it takes to lose half of its strength.

- Thermal pollution from cooling systems.

- i. Future needs associated with nuclear energy

- Develop environmentally acceptable methods to dispose of nuclear waste.
- Reduce the cost of construction of nuclear electric generating plants.
- Promote the use of nuclear energy to conserve oil and gas supplies.
- Use nuclear energy to reduce air pollutants.

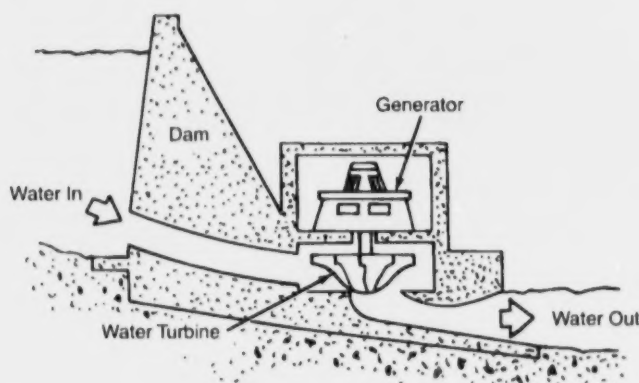
Information Sheet

Objective 8

Hydropower energy resources

- a. Hydropower is energy developed by the force of moving water.
- b. Dams are used to harness the energy of falling water.
- c. Water flowing through turbines turn generators which produce electricity.

Figure 13



- d. The United States currently uses hydropower to generate 14% of its electricity.
- e. Hydropower is the most economical source of electricity.
- f. Environmental considerations of hydropower.
 - Dams create artificial reservoirs, which may affect fish and wildlife, destroy scenic rivers, and flood agricultural land.
 - Dams cause downstream water levels to fluctuate and affect water quality.
- g. Future of hydropower
 - More than 1900 dams in the United States are currently producing electricity.
 - The number of hydropower generating plants is expected to increase.

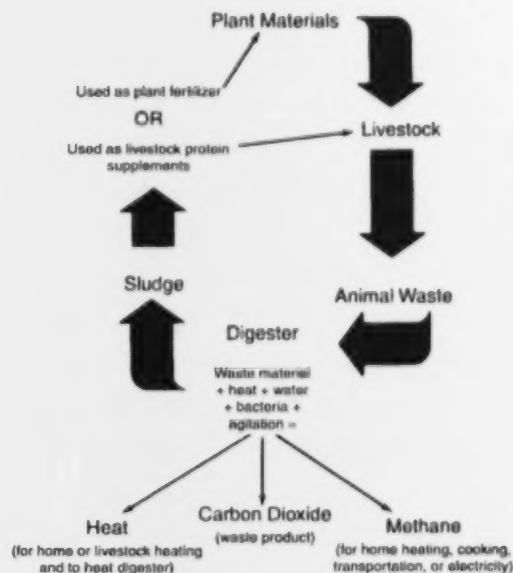
Objective 9

Biomass energy resources

Key term:

- **Biomass**—Any plant derived organic matter available on a renewable basis
 - a. **Biomass** conversion or biogenesis uses plant materials and animal waste as sources of fuel.
 - Wood is used as a direct heat source and to produce steam for electric generation.
 - Corn, soybeans, or other grains may be used to produce alcohol which can be mixed with gasoline and used in internal combustion engines.
- Examples: Ethanol, biodiesel
- Animal waste and municipal sewage produce methane gas when broken down by bacteria.

Figure 14



- b. Wood supplies less than 2% of the total energy demands in the U.S.
- c. The economics of biomass as an energy source is dependent on the cost of competing resources such as coal, oil, and natural gas.

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Information Sheet

Objective 10

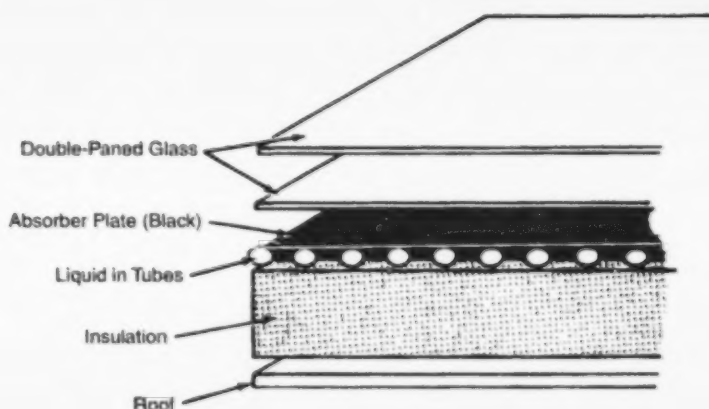
- d. As grain consumption from alcohol production increases, food prices also increase.
- e. Environmental considerations
 - While the current supply of wood in the U.S. is adequate to supply current needs in biogeneration, increased consumption could result in shortages.
 - Serious air pollution problems result from wood burning.
 - Many people feel that grains needed for food should not be used to produce fuel.
 - When biomass is converted, carbon dioxide is also produced which adds to the greenhouse effect.
- f. Future of biomass in energy production
 - If fossil fuel prices increase, biomass energy will be used more.
 - Goal for biomass energy is to increase production 11% by the year 2005.

Solar energy resources

- a. Solar low temperature systems
 - Energy from the sun is converted to useful heat called solar power.
 - There are two types of solar energy systems
 - active—captures, stores, and distributes the energy from the sun
 - passive—provides avenues for the sun to enter but relies on natural air flow to provide distribution

- Solar collectors are used to store and transmit heat.

Figure 15



- Once installed, solar systems using solar collectors for producing space heat and hot water are very economical.

Note: Initial purchase price is much higher than conventional gas or electric furnaces and water heaters.

- Solar systems supply between 40-60% of space heat and hot water needs for a home.
- Solar systems are not economically competitive at the present time for cooling a home.
- Environmental considerations of solar energy
 - Solar energy is a clean source of energy.
 - Use of solar energy will reduce the amount of pollutants produced by other energy sources.
- Future of solar energy resources
 - Solar heating will continue to be used and increase in popularity.
 - Solar systems have been installed in homes and commercial buildings.
 - The U.S. is utilizing solar energy resources to conserve energy and to reduce its dependence on foreign sources of oil.

Information Sheet

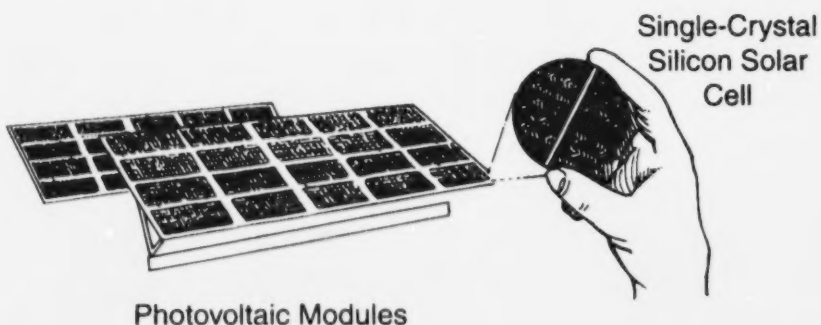
b. Solar high temperature systems

- High temperature solar systems concentrate sunlight to produce temperatures as high as 480°C (900°F).
- This temperature is required to convert water to high pressure steam required to turn turbine generators and produce electricity.
- High temperature systems cost less to build and operate than coal-fired plants.
- Environmental problems associated with high temperature systems are few.
 - Cooling water for condensing steam will present a disposal problem.
 - A system large enough to supply electricity to 15,000 homes would require 1 square mile of land.
- Future of high energy systems
 - Further research and development is needed before systems can become widely used in commercial operations.
 - Land requirements are a concern for large populations.

c. Solar photovoltaic (solar cell) systems

- Photovoltaic devices use semiconducting materials to convert sunlight

Figure 16



- Materials required to manufacture photovoltaics are available in almost unlimited quantities.

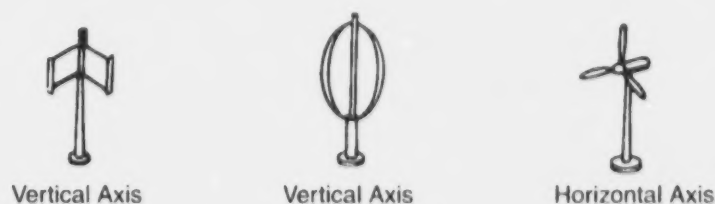
- Electricity produced from photovoltaic systems is currently not economical to use in homes and other commercial applications.
 - A one square meter photovoltaic cell will run a 100-watt light bulb.
 - Current uses of photovoltaic cells are limited to satellites, remote field applications, and calculators and small electrical devices requiring small quantities of electricity.
- Environmental problems associated with electrical production from photovoltaic cells are minor.
 - Disposal of the cells at the end of their useful life
 - Aesthetics due to the space needed for their use
- The future of photovoltaic systems
 - If efficiency is improved and costs are reduced, photovoltaic electricity could be the energy of the future.
 - It was estimated that in the year 2000, 5 million Americans were using electricity generated by photovoltaic cells.

Objective 11

Wind energy resources

- a. Wind energy is energy developed by the movement of air.
- b. Wind energy is usually harnessed by windmills or wind machines.

Figure 17



Types of Wind Machines

- c. Windmills convert wind energy into mechanical energy which powers electrical generators or mechanical pumps.
- d. Electricity produced by windmills for home use is very efficient; however, installation and maintenance costs have restricted windmill use.
- e. Large-scale wind machines capable of producing commercial quantities of electricity are still in the developmental stages.

Information Sheet

- f. Environmental problems associated with windmills are minimal.
 - Large wind machines are noisy and distracting.
 - Birds are killed by their operation.
- g. Limitations of wind energy as a power source
 - Wind does not blow all the time, and the speed which it blows vary
 - Storage batteries are necessary to store energy during low wind conditions.
 - If storage batteries are not used, an energy backup is necessary during low wind conditions and windmill maintenance.
- h. Future of wind energy
 - Small windmill systems have a promising future in small communities, farms, and rural homes.
 - In order to supply 1% of U.S. energy needs, approximately 3000 large windmills and 30,000 small windmills would be needed.

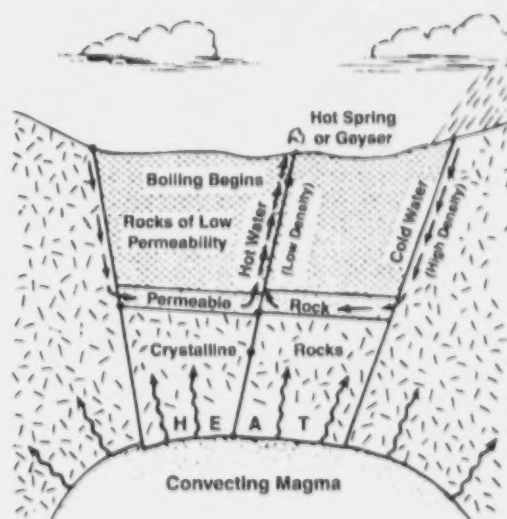
Objective 12

Geothermal energy resources

- a. Geothermal energy is produced by drilling wells to underground steam formations.

Note: In some cases wells are drilled to the earth's hot underlayment and water is circulated to this region where it turns to steam before it is returned to the surface to heat or turn turbines.

Figure 18



- b. Steam from pressurized formations is used to drive turbine generators which produce electricity.
- c. Electricity produced from geothermal energy is competitive with other energy sources.
- d. Environmental considerations
 - Air pollution from hydrogen sulfide gas in steam
 - Water pollution from salt in the geothermal steam
 - Increased seismic activity when steam pressures are reduced
- e. Future uses of geothermal energy are promising.
 - Electric generation
 - Space heating in homes and industry
 - Greenhouse heating
- f. Limitations of geothermal energy
 - Environmental problems must be solved.
 - Most geothermal resources are located in the West.

Objective 13

U.S. energy reserves (based on current consumption)

Note: Adequate **energy reserves** are vital to the national economy, security, and standard of living of the American people.

Key term:

- **Energy reserves**—Energy resources which have not been used
 - a. Coal
 - The U.S. coal reserves are the largest in the world, representing 25% of the world's total.
 - This will supply U.S. needs for 300 years at the present rate of consumption.
 - b. Natural gas
 - This reserve would supply the U.S. for 54 years.
 - Discovered resources of natural gas will supply 33 years.
 - Estimated undiscovered resources of natural gas will supply 21 years.

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Information Sheet

c. Oil

- Oil reserves in the U.S. will supply U.S. needs for 36 years. (This includes proven and estimated undiscovered reserves.)
- The U.S. has only 4% of the world's supply of oil.

Note: The world's supply of Estimated Ultimately Recoverable (EUR) oil in 1950 was 1.2 trillion barrels. In 2002 the EUR was 2.4 trillion barrels. Much of oil may not have been found yet.

- The U.S. now imports 50% of its oil from other countries.

Note: The U.S. imports 51% of its oil needs from countries in the Western Hemisphere, 21% from the Middle East, 18% from Africa, and 11% from other countries. The top three countries the U.S. imports from are Canada, Saudi Arabia, and Mexico.

- The Middle East has 66% of the world's supply.

Note: About 50% of Middle East oil is in Saudi Arabia.

d. Uranium/nuclear fuel

- The U.S. has 25% of the world's supply of this energy resource.
- This supply will last 200-300 years.
- Nuclear energy currently supplies 17% of the electricity used in the U.S.

e. The U.S. is currently using 42% of its hydropower resources.

- f. Geothermal, solar, biomass, and wind energies have great potentials; however, due to higher costs they will produce less than 3% of U.S. energy in the near future.

Objective 14

Uses of oil resources in the U.S.

Key term:

- **Barrel (bbl)**—A measure of volume of petroleum products; equal to 42 U.S. gallons

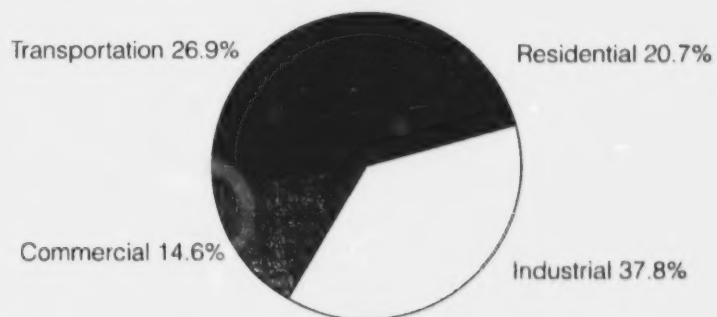
a. Residential (5 million bbl/day)

- Heating and air conditioning
- Lighting
- Appliances

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- b. Commercial/business (3.5 million bbl/day)
 - Lighting
 - Heating and air conditioning
 - Light machinery
- c. Industrial (8.6 million bbl/day)
 - Heavy machinery
 - Heating and air conditioning
 - Refining processes
 - Manufacturing processes and products
- d. Transportation (6.4 million bbl/day)
 - Cars and light trucks
 - Trucks, trains, buses, aircraft, and ships

Figure 19



Information Sheet

Objective 15

Goals of energy conservation

Key term:

- **Energy conservation**—Planned management of energy resources which conserves, protects, and prevents waste
- a. To save money
- b. To improve the environment by reducing harmful emissions from energy use
- c. To reduce the amount of energy that must be produced to meet demands
- d. To reduce our reliance on foreign energy for political and economic reasons

Objective 16

Ways to conserve energy

- a. Residential
 - Build energy-efficient homes.
 - Insulate and weatherstrip existing homes.
 - Turn off lights when not needed.
 - Set thermostat properly.
 - Reduce thermostat settings in winter.
 - Raise thermostat setting in summer
 - Purchase energy-efficient appliances.
 - Conserve hot water use.
 - Recycle household products and compost yard waste.
 - Keep doors and windows closed.
 - Keep heating and air conditioning systems in good working order.
- b. Transportation
 - Increase vehicle fuel economy by reducing weight.
 - Reduce speed.

Note: When the national speed limit was reduced to 55 mph, 200,000 barrels of oil per day were saved.

- Use car pools.
 - Increase fuel-efficiency of engines.
 - Improve aerodynamics of vehicle design.
 - Use public transportation.
 - Walk or ride a bicycle.
 - Maintain the engine.
 - Operate the vehicle properly.
- c. Commercial/businesses
- Build energy-efficient buildings and implement conservation measures.
 - Install alternate energy devices such as solar.
- d. Industrial
- Turn off equipment when not in use.
 - Improve equipment efficiency.
 - Improve manufacturing processes.
 - Reuse heat generated. (Co-generation)
 - Recycle raw materials.
- e. Electricity generation
- Conserve energy resources which are in short supply in the U.S.
 - Generate electricity by converting to U.S. energy resources which are renewable or that will last several hundred years such as coal, nuclear, hydropower, solar, or wind energy.

Information Sheet

Objective 17

Career opportunities related to energy resources

Note: The careers listed below are professional careers requiring college degrees. Numerous other positions such as technicians, aides, and laborers are available. Starting salaries are generally higher in the energy industry, if jobs are available, than in other regional careers. Salaries will depend on education level and job experience.

- a. Engineer—petroleum, mining, nuclear
- b. Geologist
- c. Chemist
- d. Physicist—nuclear, geologic
- e. Mineralogist
- f. Scientist

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Student
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* Assignment Sheets and Job Sheets are located in the Student Workbook.

Objective Sheet**Unit
Objective**

After completing this unit, the student should be able to identify common trees and the major forest regions of the United States and explain the importance of forest land to the environment. The student should demonstrate these competencies by completing the assignment sheets and job sheets and by scoring a minimum of 85 percent on the written test.

**Specific
Objectives**

After completing this unit, the student should be able to:

1. Match terms related to forestry with their definitions.
2. Select true statements related to forestry.
3. Distinguish among the main parts of a tree.
4. Identify the parts of the crown.
5. Identify the parts of the trunk.
6. Distinguish among the types of roots in a root system.
7. Select from a list ways trees are identified.
8. Select true statements concerning the photosynthesis process.
9. Complete statements concerning the growth of a tree.
10. Distinguish between the classifications of trees.
11. Select from a list common uses of trees.
12. Select from a list the benefits of forests to the environment.
13. List government agencies involved in forestry.
14. Identify the major forest regions of the United States.
15. Match the types of forest cuttings with their definitions.
16. List ways that tree stands regenerate.
17. Match forest measurements with their descriptions.
18. Identify measuring instruments used in forestry.
19. List forest enemies.
20. Select from a list the causes of fire.

Objective Sheet

21. Match types of forest fires with their descriptions.
22. Distinguish between categories of forest fires.
23. Select from a list benefits of controlled burns.
24. List career opportunities related to forestry.
25. Identify local trees. (Assignment Sheet 1)
26. Determine the age of a tree. (Assignment Sheet 2)
27. Determine uses of wood and wood by-products. (Assignment Sheet 3)
28. Solve cord measurement problems. (Assignment Sheet 4)
29. Analyze areas of conflict in maintaining forests and urban trees. (Assignment Sheet 5)
30. Analyze current reports concerning areas of conflict in forestry. (Assignment Sheet 6)
31. Plant a bareroot tree. (Job Sheet 1)
32. Measure diameter of a tree. (Job Sheet 2)
33. Measure merchantable height of a tree. (Job Sheet 3)

Information Sheet

Key terms:

- **Forest**—A complex of community of associated trees, shrubs, other plants, and animals
- **Regrowth forest**—Areas of forest that have been cut and have regrown
- **Old-growth forest**—An uncut forest
- **Forestry**—The art and science of managing forests so as to yield, on a continuous basis, a maximum quality and quantity of forest lands to satisfy human needs
- **Silviculture**—The art of producing and caring for a forest

Introduction

Since early times our **forests** and their products and by-products have always been important. From timber for our homes and factories to the pleasure of a walk in the woods, we gain many things from the forest. Forests are important to wildlife and provide recreation for outdoor enthusiasts. The best thing about the forests is that we can keep our forests and use them too! That is because forests are one of our renewable resources. Just like other plants, trees can be harvested and then replaced by new trees. Unlike most other plants, though, trees take much longer to grow to maturity.

A forest is a very complex community of associated trees, shrubs, vines, herbs, mosses, ferns, and animals. In this community, all members interact with each other and play some part in the complex system. A forest is constantly renewing itself. In a forest, food is being produced through photosynthesis every day. Plant parts decay and release their nutrients into the soil where they can be reused. Animals consume the plants or other animals. The animals, too, die and return their nutrients to the soil for reuse. Each member of the community takes its needs from the system and then, in return, contributes to the system. This balanced ecosystem is a forest.

There are six major forest regions in the United States. Each region is an area with a predominant species of trees present. Some forests are native; others are planted to improved species. Tree farms are planted to grow trees for harvest. Some native forests and all tree farms are commercial forests. A commercial forest is one that is managed to produce timber and other wood products. Most forests are **regrowth forests**. Most of the forests east of the Rocky Mountains have been cut one or more times. Only a few areas of **old-growth forest** remain. Trees also have benefits in urban areas that make life more appealing and satisfying to residents.

Forest resources are of great importance to America in many ways — for aesthetic values, environmental improvement, soil and water conservation, and certainly economic production. Forests cover vast areas of land in all our states. With such a vast area in trees, you might think the forests could take of themselves. After all, trees start out as seedlings, grow to maturity, and are cut down. But it is not that simple. Our population continues to grow; our cities, industries, and residential areas continue to expand. Our forested land continues to diminish. And, at the same time, we still insist on using more and

Information Sheet

more wood and other forest products each year. Without the use of good forest management techniques, increased production from a decreased area would not be possible.

The study of forests and associated communities is known as **forestry**. **Silviculture** is used to improve forests so they will be more productive. It includes planting, thinning, cleaning, liberating, harvesting, and protecting forests. Wildlife can be promoted as part of silviculture work. The objectives of forest management should take into account not only the immediate but also the long-term future. Forest management plans should always consider the responsible use of the forest resource and its proper regeneration.

Objective 1

Terms and definitions

Chlorophyll	Old-growth forest
Conifer	Photosynthesis
Deciduous	Regrowth forest
Forest	Silviculture
Forestry	Tree

Objective 2

Statements related to forestry

Note: Statistics are from forestinformation.com—2001.

- a. There is approximately 9.8 billion acres of forests worldwide (29.6% of the total land base).
- b. The total acres of forests are decreasing worldwide.
- c. There are about 747 million acres of forests in the United States (33% of the total land base).
- d. Today, the United States has about the same area of forestland as it did in 1920.
- e. Thirty-three percent (33%) of the U.S. forest and woodlands are non-commercial forestland.

Note: Non-commercial forestland is not suited for economical tree production. Examples include swamps, very rough mountainous areas, parks, wilderness preservation areas, game refuges, and other areas where timber harvest is not allowed. There is approximately 250 million acres of non-commercial forestland.

- f. Sixty-seven percent (67%) of the U.S. forestland is referred to as commercial forest.

Note: Commercial forest is land capable of producing economically useful forest. There is approximately 495 million acres of commercial forest.

- g. Individuals own 58% of the commercial forests; federal, state and local governments own 28%; and the forest product industries own 14%.

Note: Forest product industries include such corporations as Weyerhaeuser, Kraft, Union-Camp and others.

- h. Only 50% (approximately 250 million acres) of the commercial forestland is actually producing forests.

Note: Many parcels are too small; forests are too near homes, highways, lakes, and/or streams; or land is not being managed for wood production.

Objective 3

Main part of a tree

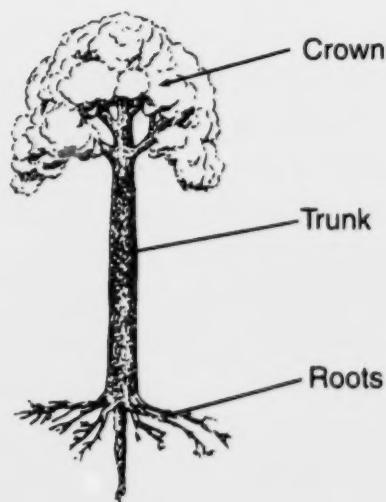
Key term:

- **Tree**—A single-stemmed woody plant usually over 20 feet high at maturity

Note: Dendrology is the study of **trees**.

Figure 1

- a. **Crown**—The foliage and flowering/fruiting part of a tree
- b. **Trunk**—The main stem of the tree that transports nutrients
- c. **Roots**—The underground part of a tree that extracts nutrients from the soil and atmosphere



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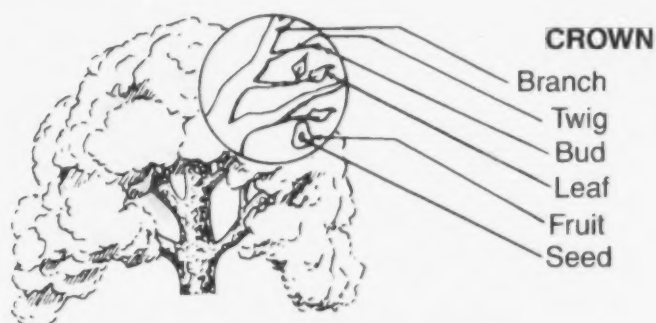
Information Sheet

Objective 4

Parts of a crown

- a. Branches—Larger, outgrowing stems from the trunk
- b. Twigs—Smaller stems from the branches
- c. Buds—Small, growing projections at the ends or sides of stems that may develop into a flower, leaf, or shoot (new twig)
- d. Leaves—Single unit of foliage that functions primarily in food manufacture through photosynthesis
- e. Flower— The reproductive part of a seed-bearing plant
- f. Fruit—The edible, more or less soft product of a plant, consisting of ripened seeds and adjacent tissues or tissue only (seedless)
- g. Seeds—The small bodies produced by flowering plants which are capable of developing by germination (sprouting)

Figure 2

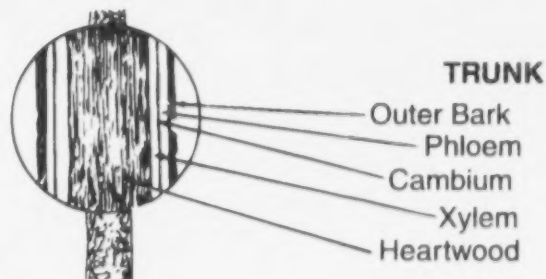


Objective 5

Parts of a trunk

- a. Outer bark—Protects tree from injuries
- b. Phloem—Carries food from leaves to twigs, branches, trunk, and roots
- c. Cambium—Living cells that divide to form phloem and xylem
- d. Xylem—Carries sap from roots to leaves
- e. Heartwood—Dead cells that give strength to the tree

Figure 3

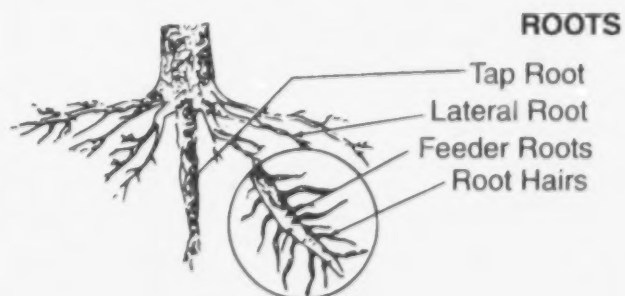


Objective 6

Types of roots and their functions

- a. Lateral roots—Grow horizontally and help keep the tree upright
- b. Tap roots—Grow vertically downward and anchor the tree
- c. Feeder roots and root hairs—Absorb water and minerals

Figure 4



Information Sheet

Objective 7

Ways trees are identified

Note: Not all of the following are present on the tree at the same time depending on the season and the type of tree.

- a. Leaves
- b. Fruits
- c. Bark
- d. Buds
- e. Twigs
- f. Flowers
- g. Wood
- h. Growth habit
- i. Overall form

Objective 8

Photosynthesis

Key terms:

- **Photosynthesis**—The process of producing carbohydrates from water, carbon dioxide, chlorophyll, and light
- **Chlorophyll**—Green photosynthesis coloring matter in plants

- a. The leaves of a plant use sunlight, carbon dioxide, **chlorophyll**, and water to produce carbohydrates.
- b. Oxygen is given off as a by-product.
- c. Carbohydrates, including sugars and starches, are later converted to fats and proteins.
- d. Fats and proteins are used as food for growth and respiration or are stored in the plant for later use.

Objective 9

Growth of a tree

- a. Trees begin growth in the spring when the temperature is warm enough.
- b. Growth is slower in the summer because of the hot, dry weather.
- c. Cells are the building blocks of trees.
- d. Root tips, twigs, and branches increase in length when cells become longer.

Information Sheet

- e. The tree increases in diameter when cells under the bark divide.
- f. New growth from under the bark forms the annual ring.
- g. One ring is produced each year.
- h. The age of a tree can be determined by counting the number of rings from the center out to the edge.
- i. The width of the growth ring indicates the tree's growing conditions that year.

Objective 10

Classification of trees

Key terms:

- **Deciduous**—Plants that shed all their leaves at the end of the growing season and remain leafless during the dormant (non-growing) season
- **Conifer**—Trees that bear seeds on cones and that have long, narrow (needle-like) leaves

- a. **Hardwood**—Wood produced by **deciduous** (broadleaf) trees
- b. **Softwood**—Wood produced by **conifers**

Note: This classification does not always indicate the degree of hardness of the wood. Some softwoods such as firs are actually harder than some hardwoods such as fruit trees.

Objective 11

Common uses of trees

Note: Depending on the type of tree, it may have several uses. For example, an apple tree is ornamental when it blooms, it produces fruit, it gives shade, and its wood may be used for various products.

- a. **Shade**—As shields from the sun which help to cool nearby areas in the summer
- b. **Windbreaks**—As shields from undesirable winds and to reduce wind erosion
- c. **Privacy and noise buffers**—As shields from undesirable views or noises
- d. **Ornamental use**—For beauty in a landscape
- e. **Fruit and nut production**
- f. **Timber production**—Various uses of wood products

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Information Sheet

Objective 12

Benefits of forests to the environment

- a. Influence the climate
- b. Retain snowmelts
- c. Prevent floods
- d. Control water erosion
- e. Control wind erosion
- f. Provide habitats for fish and wildlife
- g. Remove pollutants from the environment
- h. Provide organic matter (leaves, decaying parts) to the soil
- i. Provide oxygen to the atmosphere
- j. Remove carbon dioxide from the atmosphere

Objective 13

Government forestry agencies

Note: Agencies provide services and resources to private landowners and/or public lands.

- a. U.S. Forest Service
- b. National Park Service
- c. Bureau of Land Management
- d. Bureau of Indian Affairs
- e. State forestry service
- f. City and county governments

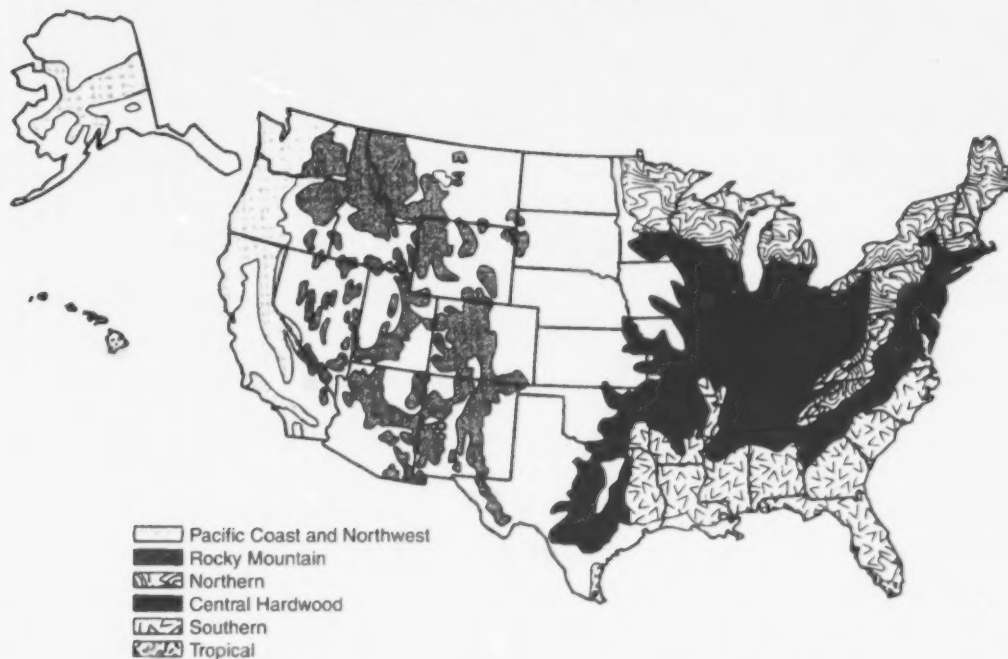
Objective 14

Major forest regions of the United States

- a. Pacific Coast and Northwest
- b. Rocky Mountain (Western)
- c. Northern
- d. Central Hardwood
- e. Southern
- f. Tropical

Figure 5

Forest Regions of the United States



Objective 15

Types of forest cuttings

- a. Harvest cuttings Removing financially or physically mature (marketable) trees for timber
 - Selective cutting—Individual marketable trees are selected and cut; commonly used in uneven-aged stands

Information Sheet

- Clear cutting—All the trees in a stand are harvested in a single operation; commonly used in even-aged stands

Note: A variation of clear cutting is the seed-tree method where single or small groups of superior trees are left to produce seed for regeneration.

- b. Intermediate cuttings—Cuttings made in an immature stand to improve the stand's composition and character

Note: Intermediate cuttings are often termed "timber stand improvement."

- Thinning—Removing surplus trees, thereby reducing competition and improving the growth and quality of the remaining trees
- Release cutting—Resembles thinning but is used to regulate species composition or improve the growth and quality of a young stand up to sapling size; also used to remove or control competing vegetation other than trees
- Improvement cutting—Adjusts species composition and tree quality in previously unmanaged stands that are older than the sapling stage; removes trees of undesirable species, poor form, and unhealthy condition
- Salvage cutting—Removing trees killed or damaged by fire, ice, storms, or natural catastrophes
- Sanitation cutting—Removing trees damaged by diseases or insects

Objective 16

Ways that tree stands regenerate

- a. Seeding (natural or direct)
- b. Stump sprouting
- c. Planting of seedlings

Objective 17

Forest measurements

- a. Cord—A stack of wood 4 feet by 4 feet by 8 feet or 128 cubic feet
- b. Board ft.—Rough wood one foot square and one inch thick
- c. Cubic ft.—Rough wood cube one foot on each side; contains 12 board feet
- d. Weight—Used commonly in the pulp and paper industry
- e. Piece—Refers to the number of boards of a specific dimension
- f. Diameter—The distance across a tree at 4.5 feet above the ground

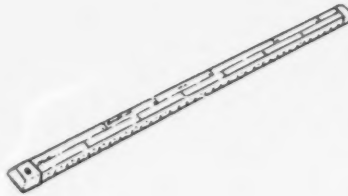
Note: This is also referred to as diameter breast high (DBH).

Objective 18

Measuring instruments used for forestry

- a. Tree scale (Biltmore) stick—
Used to measure tree diameter
and tree height

Figure 6



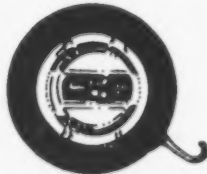
- b. Increment borer—An auger-like
tool used to extract cores from
trees for the determination of
growth and age

Figure 7



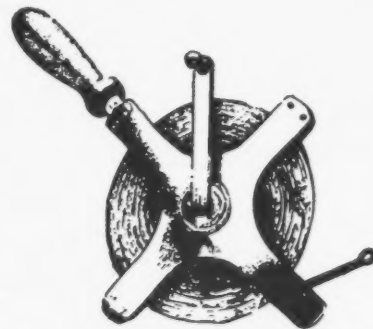
- c. Diameter tape—Used to directly
measure the diameter of a tree

Figure 8



- d. Chains or tapes—Used to
determine horizontal distances

Figure 9



Objective 19

Forest (tree) enemies

- a. Insects

Examples: Bark beetles, reproduction weevils, pine tip moths, budworms, gypsy moths, tent caterpillars, leaf rollers, stem borers

Information Sheet

	b. Diseases • Noninfectious diseases—Caused by environmental stress Examples: Maple decline, birch dieback, sweet gum blight • Infectious diseases—Caused by parasites and fungi Examples: Rust, root rot, mistletoe, stem decay, canker, Dutch elm disease, oak wilt c. Physical damage • Overgrazing • Construction of buildings and roads • Wind d. Fire • Accidental • Intentional
Objective 20	Causes of fire a. Arson b. Debris burning c. Cigarettes, cigars, pipes d. Railroads e. Logging operations f. Lightning
Objective 21	Types of forest fires a. Ground fires—Burn the organic materials beneath the surface litter b. Surface fires—Burn the surface litter c. Crown fires—Burn from top to top of trees or shrubs
Objective 22	Categories of forest fires a. Wildfire—Fires burning out of control b. Controlled (prescribed) burn—Any burning that has been started intentionally as a forest management tool

Objective 23

Benefits of controlled burns

- a. Reduces the hazard of wildfire
- b. Readies the area for seeding and planting
- c. Stimulates sprouts and seedlings, thereby improving food sources for many wildlife
- d. Removes undesirable trees and brush
- e. Controls forest diseases
- f. Increases nutrient levels in forage
- g. Creates openings in dense forest stands which encourages natural regeneration of forest
- h. Makes access to the forest easier

Objective 24

Career opportunities related to forestry

- a. Foresters

Note: This includes timber sale inspectors, administrators, assistants, and silviculturists.

- b. Forestry technicians
- c. Loggers
- d. Log scalers
- e. Forestry researchers and industry representatives

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6—Analyze Current Reports Concerning Wildlife Management ...	137
* Assignment Sheets are located in the Student Workbook.	

Objective Sheet

Unit
Objective

After completing this unit, the student should be able to create a food web showing the interconnecting food chains in an ecosystem, compile a profile of a wildlife species, and discuss why it is necessary to manage wildlife. The student should demonstrate these competencies by completing the assignment sheets and by scoring a minimum of 85 percent on the written test.

Specific
Objectives

After completing this unit, the student should be able to:

1. Match terms related to wildlife management with their definitions.
2. Complete statements concerning a food chain.
3. Show interconnections in a food web.
4. Complete statements concerning the predator/prey relationship.
5. Complete statements concerning the history of wildlife in the United States.
6. Match federal legislation concerning wildlife with their definitions.
7. Distinguish between vertebrate and invertebrate wildlife.
8. Select from a list characteristics of a mammal.
9. Distinguish between small mammals and large mammals.
10. Select from a list characteristics of fish wildlife.
11. Select from a list characteristics of birds.
12. Distinguish among major types of birds.
13. Select from a list characteristics of reptiles.
14. Select from a list characteristics of amphibians.
15. Match types of invertebrate wildlife with their descriptions.
16. Match the classifications of wildlife that need protection with their descriptions.
17. List dangers to wildlife populations.
18. List agricultural practices that support wildlife.
19. Select from a list the wildlife activities that may cause damage to agriculture.

Objective Sheet

20. List ways to control wildlife damage problems.
21. Select true statements concerning public wildlife and private lands.
22. Match the types of private wildlife production areas with their descriptions.
23. List government agencies involved in wildlife management.
24. List career opportunities related to wildlife management.
25. Explain effects on a food chain when parts are removed.
(Assignment Sheet 1)
26. Create a food web. (Assignment Sheet 2)
27. Identify wildlife you see in a certain time span. (Assignment Sheet 3)
28. Compile a profile of a wildlife species. (Assignment Sheet 4)
29. Make management decisions concerning a deer herd.
(Assignment Sheet 5)
30. Analyze current reports concerning wildlife management.
(Assignment Sheet 6)

Information Sheet

Key terms:

- **Wildlife**—All plants, animals, and other living things that have not been domesticated
- **Domesticated**—Wildlife taken from nature and raised in a controlled situation
- **Habitat**—The area where an animal or plant naturally lives and grows
- **Wildlife management**—The scientifically-based activity of making land produce sustained annual crops of wild game
- **Ecosystem**—The interacting system of biological community and its nonliving environment

Introduction

Most of the living things on Earth are **wildlife**. The term, wildlife, may be broadly defined as all plants, animals and other living things that have not been domesticated. Domestication is the process of bringing things under the control of humans. Common **domesticated** organisms include animals such as dogs, cats, sheep, horses, and cattle and plants such as tomatoes, cotton, beans, and petunias. Domestication is important in producing the food and clothing people need.

As the human population continues to grow, demand for space will reduce or eliminate wildlife populations. New roads, power transmission lines, pipelines, lakes, home sites, schools, shopping centers, and other human activities will threaten wildlife. Smaller areas will be available for wildlife. Making good use of these areas is essential.

Wildlife conservation is the wise use of wildlife resources. It involves maintaining a **habitat** that supports a species or community of species and protecting wildlife from destruction. The emphasis is on people making good decisions. Wildlife conservation is closely related to land use. Most people recognize the importance of maintaining wildlife and preventing waste. Many people, however, fail to realize what is involved.

Wildlife management is an important part of wildlife conservation. Understanding **ecosystems** is a major goal in successful wildlife management. This includes habitat production and human use of wildlife. In some cases, the practices involved are very complex. Wildlife management helps to maintain wildlife production. This will provide adequate wildlife for human enjoyment.

In this unit, you will be introduced to animal wildlife and why it is important to manage wildlife.

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Information Sheet

Objective 1

Terms and definitions

Carnivores	Herbivores
Domesticated	Omnivores
Ecosystem	Predator
Food chain	Prey
Food web	Wildlife
Food plot	Wildlife management
Habitat	

Objective 2

Food chain

Key terms:

- **Food chain**—An arrangement of predator-prey relationship in an ecosystem
- **Herbivores**—Animals that eat plants
- **Carnivores**—Animals that eat meat (other animals)
- **Omnivores**—Animals that eat both animals and plants

a. A **food chain** is the connecting link between various organisms as they eat to survive and multiply.

b. On the first level of the food chain are the "producers".

Examples: Green plants—Grass, shrubs, trees

c. On the second level of the food chain are the "**herbivores**" which consume plant material to survive.

Examples: Grasshoppers, mice, rabbits, deer, birds

d. On the third level of the food chain are the "**carnivores**" which consume herbivores to survive.

Examples: Coyote, hawk, mountain lion, owl

e. Some organisms consume food at more than one level. They are called "**omnivores**".

Examples: Bears eat berries (from plants) and fish; birds eat plant nuts or fruit as well as worms and insects

f. Examples of straight food chains would include:

Grass, shrubs, tree leaves → deer → mountain lion

Grass → grasshopper → frog → snake → hawk

Grass → mouse → owl

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Objective 3

Interconnections in a food web

Key term:

- **Food web**—The interconnected food chains within an ecosystem.

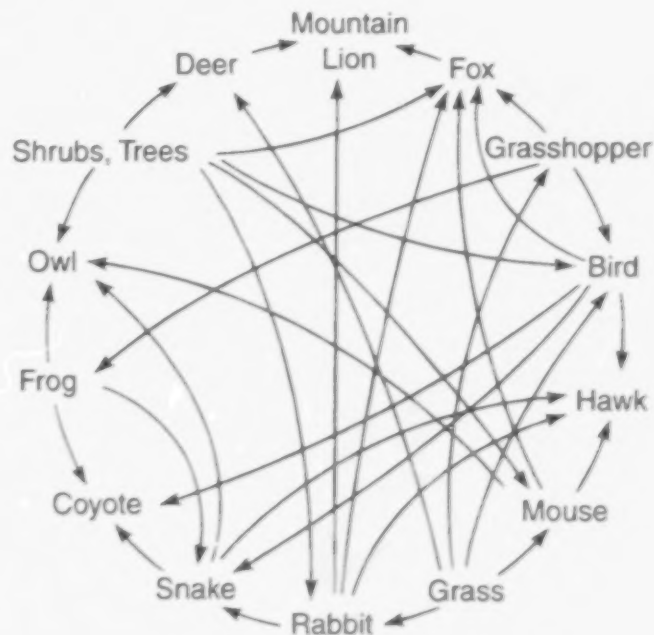
- a. A **food web** shows the interconnecting food chains in an ecosystem.
- b. Each organism is generally a part of more than one food chain.
- c. Not all food chains travel in a straight manner.

Example: An owl may consume a frog which has consumed a cricket. The owl may also consume a rabbit which has consumed grass.

- d. Members of a food web are dependent on each other for survival. Any change in the ecosystem affects all members of that food web.
- e. In a diagram which connects various organisms according to their food preference, the crossing lines form a food web.

Example: Food web

Figure 1



Note: Arrows point to the consumer.

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Information Sheet

Objective 4

Predator/prey relationship

Key terms:

- **Predator**—Animal that hunts, kills, and consumes other animals
- **Prey**—An animal taken as food by a predator

- a. **Predators** are not usually destructive, but they can be.
- b. Predators can be beneficial.
 - Predators can control the population of a **prey** species.
 - Predators feed on pest animals.
 - Control by predators can keep the prey species healthy.
 - Predators maintain populations by killing weak individuals of the prey species.
- c. Humans are the only predators capable of exterminating a prey species.

Objective 5

History of wildlife in the United States

- a. North America became established in the world fur trade business as French trappers cooperated with Native Americans in the 1700s.
- b. Westward expansion of settlers during the 1700s and 1800s was responsible for loss of wildlife habitat and aided market hunting.
 - Massive herds of bison had been slaughtered by the 1880s.
 - Native herds of elk, flocks of prairie chickens and passenger pigeons were nearly eliminated by 1900.

Note: The last known passenger pigeon died in 1914.

- c. States began setting bag limits and outlawing market hunting in the late 1800s.
 - d. Federal legislation began setting aside national parks and wildlife refuges in 1916.
 - e. Hunters and anglers asked for, and helped pass legislation to fund wildlife management.
 - Pittman-Robertson Act, 1937
- Note: Pittman-Robertson Act funds have amounted to more than \$2 billion since they were first collected.
- Dingell-Johnson Act, 1951

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- f. In 1934 federal legislation was passed requiring "Duck Stamps" for waterfowl hunting to provide funds for waterfowl habitat restoration.

Note: Canada also requires "Duck Stamps" for waterfowl hunting.

- g. Hunting groups formed private fund-raising organizations to enhance habitat for various species.

- Ducks Unlimited
- Quail Unlimited
- Pheasants Forever

- h. There have been dramatic increases in formerly threatened species through science-based wildlife management.

- North American elk—Nearly 500,000 today, compared with fewer than 100,000 in 1920.
- Wild turkey—More than 2 million nationwide, compared with relatively few found only in some southern states in 1930.
- White-tail deer—More than 14 million nationwide, compared with fewer than 500,000 in 1920.
- Pronghorn antelope—More than 750,000 today, compared with fewer than 25,000 in 1920.

Objective 6

Selected federal legislation concerning wildlife

Note: As amendments or refunding are added to the original bills, the names sometimes change, but the following names are still commonly used.

- a. **Lacey Act**—Brought the federal government into the business of wildlife law enforcement.
- b. **Fish and Wildlife Conservation Act**—Called for identification of fish and wildlife not taken for sport or commercial purposes.
- c. **Migratory Bird Conservation Act (1934) or "Duck Stamp" Program**—Funded by a special annual fee paid by active hunters and non-hunting friends of wild waterfowl to acquire refuges and to lease wetlands for the primary benefit of migratory birds.
- d. **Federal Aid in Wildlife Restoration Act (1937) or Pittman-Robertson Act**—Provided funding for wildlife management by placing an excise tax on firearms and ammunition (later on archery equipment); provides for nearly 70 percent of federal funds for wildlife study, restoration, and education.

Information Sheet

- e. **Federal Aid in Sport Fish Restoration Act (1951) or Dingell-Johnson Act**—Provided funding for fish management by taxing fishing and boating equipment.
- f. **Endangered Species Act (1973)**—Gave authority for protecting rare and endangered species to the U.S. Fish and Wildlife Service.
- g. **North American Waterfowl Management Plan (NAWMP) (1986)**—Partnership between U.S. and Canada to protect 37 species of North American waterfowl (ducks, geese, swans) shared by both countries.
- h. **Conservation Reserve Program (1985)**—Provided for areas of wildlife habitat on farms near crops.

Objective 7

Vertebrate and invertebrate wildlife

- a. Vertebrate wildlife — Animals with backbones.

Note: The backbone contains a spinal cord that is important in operation of the nervous system.

Examples: Mammals, fishes, birds, reptiles, and amphibians

- b. Invertebrate wildlife—Animals without an internal skeleton.

Note: Invertebrate animals have an exoskeleton or body covering made of hard materials that provide body structure and protect the internal organs.

Examples: Insects, crustaceans, mollusks, worms, and arachnids.

Objective 8

Characteristics of a mammal

- a. The females give milk to their babies.
- b. Have a heart with four chambers.
- c. Have the capacity to maintain a constant body temperature.

Note: This trait is called endothermic and is also referred to as warm blooded.

- d. May be classified based on digestive systems

Note: Knowing the digestive system helps in providing appropriate habitat and food.

- Single-compartment stomachs (monogastric stomach)

Examples: Monkeys, squirrels, sea lions, wild pigs

- Ruminants

Examples: Bison, deer, antelope, camels, llamas, giraffes

Objective 9

- e. Over 4,000 species of mammals have been identified.
- f. Most mammals are terrestrial and live on land.
- g. Some mammals are aquatic. Examples: Manatee, common dolphin, and killer whale
- h. One class of mammal is capable of true flight—the bat.

Common mammals

a. Large mammals

Elk (Wapiti)	Mountain goat
Deer	Moose
Sheep	Pronghorn antelope
Bison	Bear
Bighorn sheep	

b. Small mammals

Lynx	Badger	Wolverine
Marmot	Squirrel	Prairie Dog
Beaver	Muskrat	Opossum
Raccoon	Weasel	Mink
Fox	Coyote	Porcupine
Skunk	Chipmunk	Woodchuck
Hare	Rabbit	Bobcat

Objective 10

Characteristics of fish wildlife

- a. Body temperature adjusts to surroundings
Note: This trait is referred to as ectothermic.
- b. Have paired fins and an exterior covering of scales or skin.
- c. Get oxygen from water through a gill structure.

Information Sheet

Objective 11

- d. Many reproduce by laying infertile eggs that are fertilized by the male outside the body of the female.
- e. Common fish include: trout, salmon, catfish, crappie, bass, bluegill, pike, perch, sturgeon, tuna, and shark

Characteristics of birds

- a. Have a body covered with feathers.

Note: Birds are the only animals with feathers.

- b. Most birds have the ability to fly.

Note: Bird's bones are filled with air spaces, which makes them lightweight and flying easier.

- c. Has a pair of wings and a pair of legs.

- d. Are endothermic (warm blooded).

- e. All birds hatch from eggs.

- f. Scientists have identified some 9,700 bird species worldwide.

Note: The smallest bird is the hummingbird and the largest is the ostrich.

- g. Are in the Aves scientific class.

Note: This has led to calling the place where birds are kept an aviary.

Objective 12

Major types of birds

- a. Upland nonmigratory birds

- Grouse
- Quail
- Pheasant
- Wild turkey
- Partridge

- b. Wetland migratory birds

- Ducks
 - Mallard
 - Teal
 - Wigeon
 - Redhead
 - Scaup
 - Ruddy
 - Shoveler

- Wood
- Merganser
- Canvasback

- Geese

- Canada goose
- Snow goose
- White fronted goose

- Cranes

- Sandhill crane
- Whooping crane
- Blue heron

c. Raptors

- Eagle
- Falcon
- Osprey
- Hawk
- Owl

Objective 13

Characteristics of reptiles

- a. Are ectothermic animals (has same body temperature as its surroundings).
- b. Outer covering has scales or plates to protect against water loss by the body and offer protection from physical attack.
- c. Reproduce by laying eggs.
- d. Common reptiles include: alligators, crocodiles, turtles, lizards, and snakes.

Objective 14

Characteristics of amphibians

- a. Have bodies covered with a thick skin.
- b. Typically live in water in the early stages of their lives and move to land as they mature.
- c. Adults have lungs, legs, and eat animal foods, such as insects.
- d. Life begins as eggs and hatch into larvae with external gills.
- e. Common amphibians include: Frogs, toads, and salamanders

Information Sheet

Objective 15

Types of invertebrate wildlife

- a. Insects—Primarily terrestrial animals, they have an exoskeleton, six pairs of legs and most can fly. They reproduce by laying fertile eggs.

Examples: Mosquitoes, butterflies, wasps, bees, lady bug, crickets, grasshoppers, cockroaches, and flies

- b. Crustaceans—An animal with a strong exoskeleton, which is shed as it grows. They have four pairs of appendages (used for walking or grasping), plus two pairs of antennae on the head.

Examples: Crawfish, lobster, shrimp, water fleas, and crabs

- c. Mollusks—Small, soft-bodied animal without an internal skeleton. Some have a hard shell.

Examples: Bivalves (two-part shells that open and close)—oysters, clams, and muscles; gastropods (single-part shell)—snail; cephalopods (do not have shells)—squids and octopuses

- d. Worms—Usually have soft bodies and no legs, wings, or antennae.

Examples: Segmented—earthworm and leech
Flatworms—planaria, flukes, and tapeworms
Roundworms—nematodes, hookworms, pinworms, trichina, and filaria.

Note: Flatworms and roundworms are well known parasites of humans and other animals. Nematodes may pose problems in the soil by destroying plant roots.

- e. Arachnids—All have four pairs of walking legs, plus two other pairs of appendages near their heads.

Examples: Spiders, ticks, mites, daddy longlegs, and scorpions.

Objective 16

Classifications of wildlife that need protection

Note: Species are endangered when they are no longer able to reproduce. Food supply, loss of land or water areas, and other activities cause endangerment. Some species may lack the ability to adapt to new situations.

- a. Extinction — The disappearance of living organisms from the earth. This occurs when a species does not reproduce and dies off. Death of the last member ends the existence of a species.

Examples: Prehistoric times — dinosaurs
Modern times—(birds) passenger pigeon, dodo, great auk, moa, and dusky seaside sparrow, (mammals) quagga (kind of a zebra) and Steller's sea cow, (reptile) abingdon tortoise

- b. **Endangered species**—A plant, animal, and other species threatened with becoming extinct. The species is not reproducing itself in sufficient numbers to assure survival.

Examples of U.S. endangered species: Brown pelican, Southern bald eagle, Attwater's prairie chicken, Ivory-billed woodpecker, Red wolf, Black-footed ferret, Kemp's ridley turtle, Houston's toad, and star cactus.

- c. **Threatened species**—A plant, animal, or other species that faces serious dangers and is likely to become endangered.

Note: Threatened species have low populations. In the United States, more than 100 species are listed as threatened.

- d. **Rare species**—A wildlife species that exists in small numbers. For some reason, the species may appear to be declining.

Note: Rare species are often maintained in zoos, refuges, and other locations where they are protected.

Objective 17

Dangers to wildlife populations

- a. Illegal hunting
- b. Predators
- c. Starvation
- d. Droughts
- e. Storms
- f. Diseases
- g. Parasites
- h. Fires
- i. Accidents
- j. Human activities including pollution
- k. Loss of habitats through development or agriculture

Information Sheet

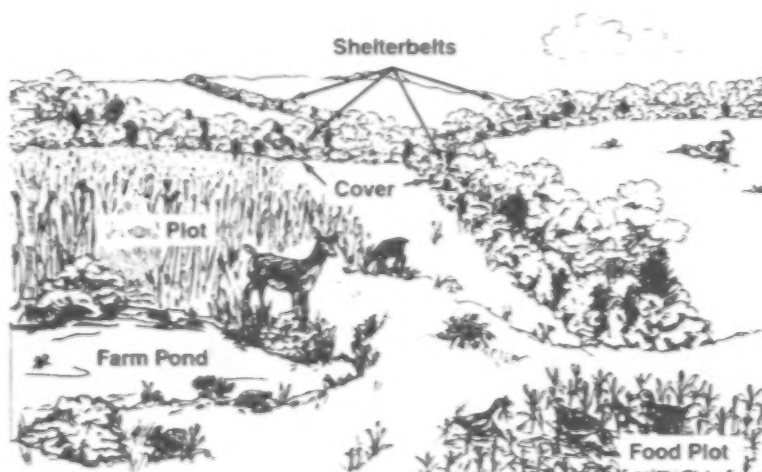
Objective 18

Agricultural practices that support wildlife

Key term:

- **Food plot**—Area planted to maintain wildlife food supply
 - a. Farm around hills (contours) to control sediment that might enter and ruin ponds, lakes, and streams.
 - b. Leave fence rows undisturbed to provide cover so wildlife can travel to other areas.
 - c. Provide farm ponds and tanks for wildlife drinking water.
 - d. Use windbreaks and shelter belts to provide habitat for wildlife.
 - e. Seed legumes and grasses to provide food cover for wildlife.
 - f. Leave brush and dead (den) trees to provide nesting cover for wildlife.
 - g. Prevent overgrazing on grassland to protect escape cover, nesting cover, and food for wildlife.
 - h. Leave crop residue on the land to provide food for wildlife and control erosion.
 - i. Provide **food plot** areas to keep wildlife away from crops.
 - j. Maintain existing wetlands to assure future wildlife habitat.

Figure 2



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Objective 19

Wildlife activities that may cause damage to agriculture

- a. Carry diseases

Note: Diseases can be passed from wildlife to domestic animals and from domestic animals to wildlife.

- b. Prey on domestic livestock and poultry
- c. Feed on agricultural crops
- d. Compete for grass on grazing lands
- e. Feed on stored feed supplies
- f. Cause damage to trees
- g. Cause damage to buildings and equipment

Objective 20

Ways to control wildlife damage problems

- a. Reduce the number of destructive animals.
- b. Provide fencing or other mechanical barriers.
- c. Use frightening techniques.
- d. Encourage adequate game harvest by hunters.
- e. Adjust agricultural practices.
- f. Establish feeding and resting areas on noncrop lands.

Objective 21

Public wildlife and private lands

- a. Private lands can provide wildlife for recreation.
- b. Landowners should be provided an incentive to support wildlife.
- c. Many landowners prefer to see wildlife on their land.
- d. Wildlife share with domestic animals the farm habitat including food, shelter, and space.
- e. Most state and federal wildlife agency money is spent on public lands.
- f. Many landowners receive compensation for good land management practices from the U.S. Department of Agriculture.
- g. More than 80% of the game is harvested on private land.

Information Sheet

Objective 22

Types of private wildlife production areas

- a. Cooperatives—Landowners open their land in exchange for protection against random trespassing
- b. Preserves—Areas set aside exclusively for owners and members
- c. Commercial wildlife enterprises—Provide "package hunts"
- d. Exotic and native big game ranches—Provide a pay hunt
- e. Farms—Raise and sell wildlife animals, birds, and fish, or sell hunting leases

Objective 23

Government agencies involved in wildlife management

- a. State wildlife, conservation, and natural resource departments
- b. U.S. Fish and Wildlife Service
- c. Forest Service
- d. National Park Service
- e. USDA Natural Resources Conservation Service
- f. Corps of Engineers
- g. Bureau of Reclamation
- h. Bureau of Land Management

Objective 24

Career opportunities related to wildlife management

- a. Fishery biologist
- b. Hatchery manager
- c. Wildlife biologist
- d. Refuge manager
- e. Range management specialist
- f. Law enforcement
- g. Technicians (biological, fish, and wildlife)
- h. Conservationist
- i. Zoologist
- j. Writers
- k. Wildlife photographer

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Objective Sheet

Unit
Objective

After completing this unit, the student should be able to distinguish among various wildlife habitats and improve wildlife habitats. The student should demonstrate these competencies by completing the assignment sheets and job sheet and by scoring a minimum of 85 percent on the written test.

Specific
Objectives

After completing this unit, the student should be able to:

1. Match terms related to wildlife habitats with their definitions.
2. Match the components of a habitat with their descriptions.
3. List the objectives of wildlife habitat management.
4. Select true statements concerning habitat management principles.
5. Match common tools and techniques of habitat improvement with their uses.
6. Classify actions taken to improve wildlife habitats.
7. Select from a list causes of habitat destruction.
8. Match types of wildlife habitats with the descriptions.
9. Complete statements concerning lakes, ponds, and pothole habitats.
10. Select true statements concerning river and stream habitats.
11. Complete statements concerning wetland habitats.
12. Complete statements concerning woodland habitats.
13. Select true statements concerning rangeland habitats.
14. Select true statements concerning farmland habitats.
15. Select true statements concerning urban habitats.
16. Lay out and identify ways to improve a local habitat.
(Assignment Sheet 1)
17. Develop a management plan for a farm pond for sport fishing.
(Assignment Sheet 2)
18. Identify ways to improve a wetland habitat. (Assignment Sheet 3)
19. Determine the carrying capacity of a rangeland habitat.
(Assignment Sheet 4)

Objective Sheet

- 20. Survey wildlife foods. (Assignment Sheet 5)
- 21. Survey non-game birds at a feeding station. (Assignment Sheet 6)
- 22. Increase hummingbird habitat. (Job Sheet 1)

Information Sheet

Introduction

Key terms:

- **Habitat**—The area where a plant or animal naturally lives and grows
- **Canopy**—Leaf area of the woodland
- **Edge**—The transitional zone where one cover type ends and another begins.
- **Home range**—The area in which an animal lives and travels

A **habitat** is where wildlife lives and grows. With animal wildlife it is the food, water, and cover that supports life. A habitat for a bear is different from a habitat for a pheasant. A habitat must meet the life requirements of an animal. If it does not, the animal will die or move to another location.

Promoting a wildlife species requires knowledge of their habitats. What kind of habitat do they need? Answering this question requires study of a species and where it is naturally found.

Animal wildlife is adapted to specific habitats. Each, to a certain extent, has its own unique habitat. For example, the habitat or **home range** of an eagle might cover an area of several miles, while that of a salamander might be the closest small rock pile near water.

There are three general classifications of habitats: aquatic, terrestrial, and amphibious.

- An aquatic habitat is a water-based habitat for animals that live in water and/or depend on it for their food and reproduction. There are three factors in an aquatic environment: salinity (freshwater, saltwater, or brackish water), temperature, and water movement.
- A terrestrial habitat is a habitat for animals that live on the land. The habitat varies with an ecosystem. Some animals dig into the earth, such as the muskrat. Others primarily live in **canopies** of trees, such as some species of birds. Regardless, food, water, shelter, and space must be available. The major kinds of terrestrial habitats are woodlands, brush, grassy areas, rock and soil, and **edge**.
- An amphibious habitat is a habitat for animals that require both land and water. They use the land at one stage and water at another. Some animals get their food in the water and live on land. Other animals live in the water and get their food from the land or both land and water. Reproduction may be in the water or on the land, depending on the species. This group includes amphibians as well as some mammals, birds, and reptiles.

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Information Sheet

Habitat management usually has a goal of meeting the needs of a featured species or a mix of species. Wildlife prospers if it has good habitat. This begins with developing a habitat management plan. This plan includes an inventory of what is on the site, the goal to be achieved, and the ways and means of reaching the goal. Planting trees, seeding grass, building brush piles, establishing food plants, and assuring that water will be available are steps in promoting habitat. It may be necessary to bring in and release wildlife. They should be species that are suited to the area and will not pose problems. The best success is with re-establishing a wildlife species.

Enjoy your study of wildlife habitats.

Objective 1

Terms and definitions

Browse	Home range
Canopy	Limiting factors
Carrying capacity	Mast
Edge	Plankton
Habitat	Release cut
Habitat component	Riffles

Objective 2

Components of a habitat

Key term:

- **Habitat component**—A factor in a habitat that supports the life of a wildlife animal

- a. **Food**—Provides nutrients for growth, maintenance, and reproduction

Note: Typical wildlife food of plant origin includes: leaves, flowers, fruit, nuts, seeds, twigs and bark, and roots.

- b. **Water**—Needed for blood composition, to regulate body temperature, and to provide nutrient transport throughout the body
- c. **Cover**—Vegetation and other material providing protection for the animal

Example: Hollow trees and standing dead trees offer cover for squirrels and owls.

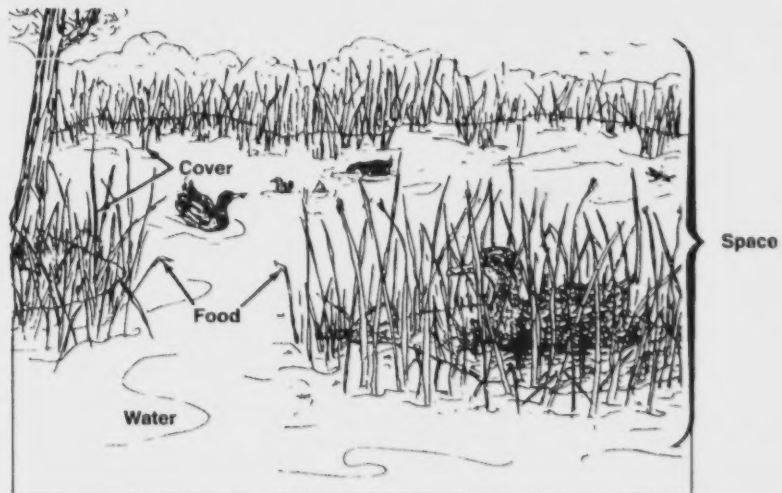
- Conceals the nest
- Helps to hide the young
- Provides resting area
- Allows escape from predators
- Protects from adverse environmental conditions

- d. **Space**—Amount of area that an animal uses to locate its food, water, and cover (home range)

Note: Space requirements vary according to the animal, season of the year, and quality of the habitat.

Examples: Squirrels need less than one acre; deer need about 650 acres; wild turkeys typically need 500 acres of range.

Figure 1



Objective 3

Objectives of wildlife habitat management

- a. To maintain a quality habitat as it exists in a natural ecosystem
- b. To improve a habitat where it has deteriorated or where a specific habitat component is lacking

Objective 4

Habitat management principles

Key terms:

- **Limiting factors**—Factors that restrict the population potential of a species
 - **Carrying capacity**—The maximum number of animals that an area can support
- a. Wildlife research helps to determine the habitat requirements of specific wildlife.
 - b. The specific habitat needs of a species vary in some degree from those of every other kind of species.

Information Sheet

- c. Some species need a highly specialized type of habitat
- d. When the basic components of a habitat are abundant and ideal, the animal species will reach its maximum potential (biotic potential).

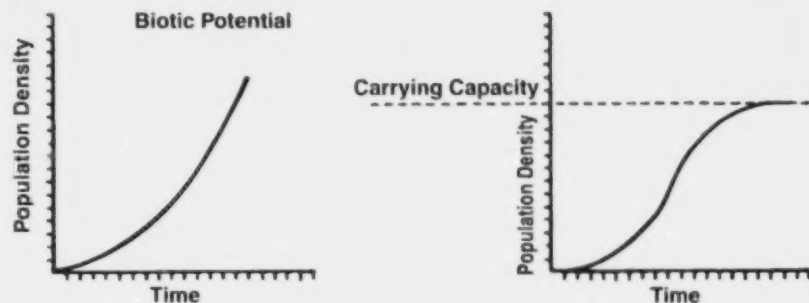
Note: Some species such as rabbits and mice have high biotic potentials, whereas, other species such as grizzly bears and bald eagles have low biotic potentials.

- e. However, species rarely reach their potential because there is almost always an environmental factor that limits the population.

Examples of **limiting factors**: Shortage of food or water, limited space, inadequate cover

- f. Each area of land (habitat) has a certain capacity for the number of animals of any one species that it can support. This is called its **carrying capacity**.

Figure 2



- g. When the population in a habitat exceeds the carrying capacity, surplus animals must either move or die.
- h. When habitat conditions change, the type and amount of wildlife present may also change.
- i. Wildlife species can be maintained only by providing suitable habitats.
- j. When habitats are damaged or destroyed, wildlife are threatened and can become endangered or extinct.

Objective 5

Common tools and techniques of habitat improvement

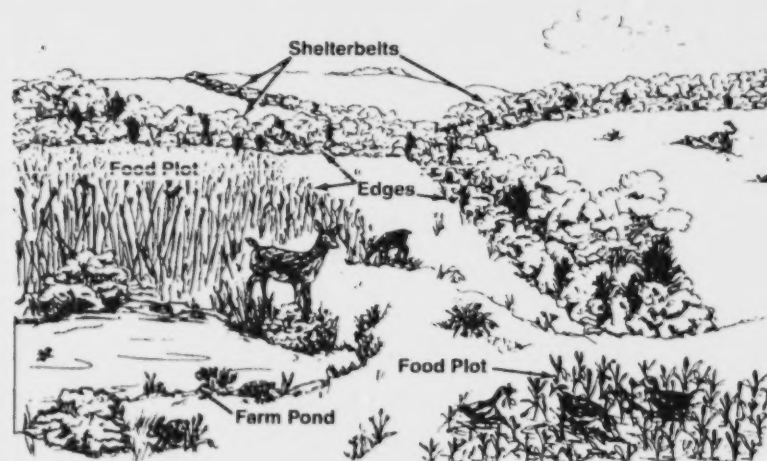
- a. **Food plots**—Planted to provide food and cover habitat
- b. **Shelterbelts**—Planted to provide escape cover, as well as protection for soil from wind erosion

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Information Sheet

- c. **Farm ponds**—Provide a habitat for fish as well as a watering place for other wildlife
- d. **Edges**—Established to provide a change between types of cover

Figure 3



- e. **Nesting structures**—Provide nesting places for species whose natural habitat has been damaged

Note: Wood ducks were endangered until nesting boxes were provided for them. Now they are an abundant species in most flyways.

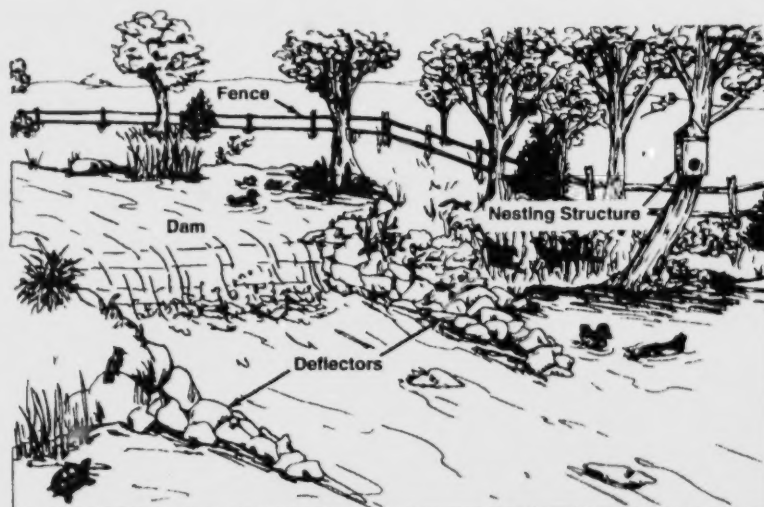
- f. **Dams**—Constructed in a stream to store water for fish and wildlife
- g. **Deflectors**—Used to control the direction of stream flow

Information Sheet

- h. **Fences**—Used to protect water and its bank from contamination or damage by domestic animals

Note: By fencing cattle out of riparian zones, one can protect stream beds and pond banks for wildlife.

Figure 4



- i. **Heavy equipment**—May be used in the removal of unwanted aquatic vegetation from some lakes, or in reshaping land for various wildlife needs
- j. **Chemicals**—Used to change the chemical composition of the water or soil either to encourage or discourage various plant and animal species

Example: Rotenone is used to control unwanted fish populations by temporarily removing oxygen from the water. As "stunned" fish float to the surface, they can be collected and removed from the body of water.

Objective 6

Actions taken to improve wildlife habitats

Key terms:

- **Mast**—Nuts of trees and shrubs (such as oak, hickory, and beech) which are used as food by animals
- **Browse**—The leaves, shoots, and twigs of trees and shrubs available for animal consumption

a. Food

- Increase **mast** or fruit production.
- Plant shrubs and trees for **browse**.
- Plant food plots of grasses and legumes.
- Provide aquatic plant vegetation.

b. Water

- Deepen existing water-holding basins.
- Trench runoff water into basins.
- Improve springs and water seeps.
- Build dams.
- Add tanks, troughs, or wells.
- Prevent water pollution.
- Create potholes.
- Control water levels.

c. Cover

- Provide protective cover.
 - Plant trees and shrubs.
 - Build brush piles.
 - Build artificial covers (roosts, reefs).
 - Renovate and reseed eroded areas.
 - Seed bare land areas.

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Information Sheet

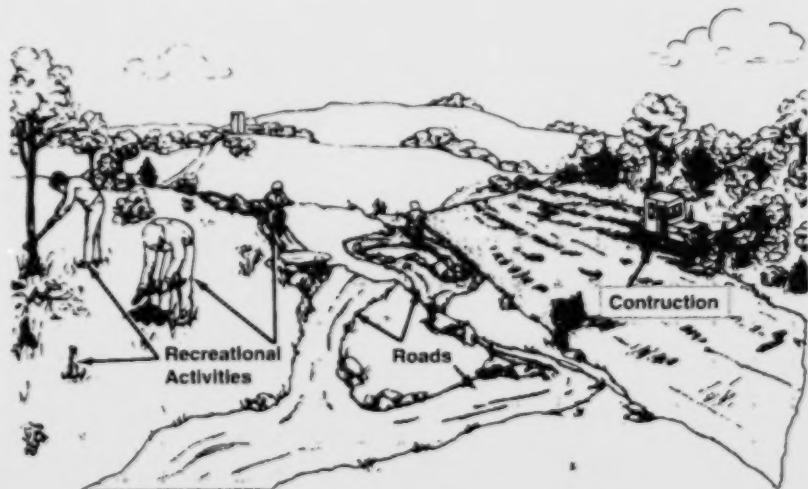
Objective 7

- Provide nesting cover.
 - Protect from excessive grazing, fires, and mowing during nesting periods.
 - Maintain existing dens or nesting trees.
 - Provide artificial nest structures.

Causes of habitat destruction

- a. Overgrazing
- b. Mining
- c. Construction
- d. Logging
- e. Roads
- f. Chemicals
- g. Recreational activities

Figure 5



Objective 8

Types of wildlife habitats

- a. **Lakes, ponds, and potholes**—Bodies of still water
- b. **Rivers and streams**—Bodies of running water
- c. **Wetland**—Land where the water table is usually at or near the surface or the land is covered by shallow water
- d. **Woodland**—Land used primarily for growing trees and shrubs; includes forests, shelterbelts, and hedge rows
- e. **Rangeland**—Land where natural vegetation is mostly grasses, forbs, and shrubs
- f. **Farmland**—Land used for agricultural practices
- g. **Urban**—Land predominantly occupied by man-made structures used for residential, commercial, and industrial purposes

Objective 9

Lakes, ponds, playa lake, and pothole habitats

Key term:

- **Plankton**—Suspended, floating, microscopic plants and animals in the water
 - a. Components
 - Deep water—Supports **plankton** and carnivorous fish
 - Shallow water—Supports aquatic vegetation and diverse aquatic populations
 - Riparian zone—Area located on the bank; supports both aquatic and terrestrial (land) plants and animals

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Information Sheet

Figure 6



b. Protecting lakes, ponds, and pothole habitats

- Fence shoreline to control livestock grazing and watering.
- Control erosion in the watershed.
- Reduce sediment draining into the lake by providing a sediment basin for all feeder streams.
- Control weeds in shallow areas.

Objective 10

River and stream habitats

Key term:

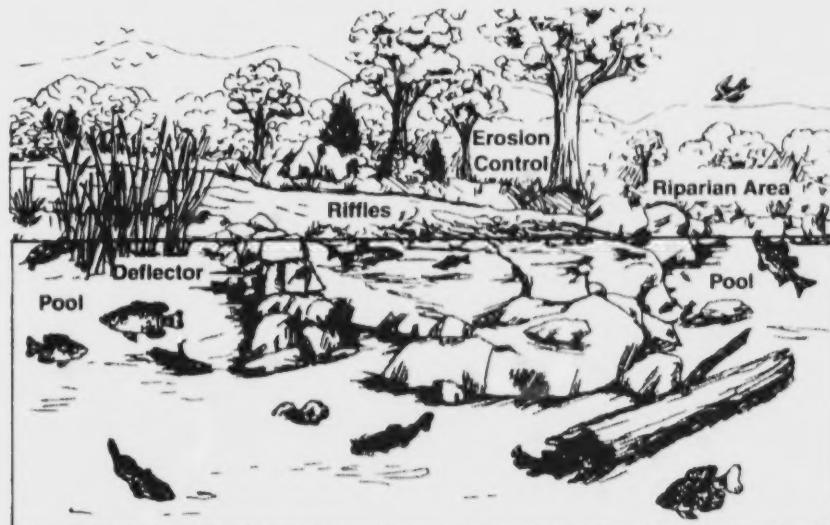
- **Riffles**—A shallow area in a stream that causes broken water

a. Components

- Streamflow pattern—A continuous flow of water with moderate spring runoff is best.
- Instream flow—A certain amount of water is needed to maintain stream habitat.
- Streambank stability—Eroding streambanks allow sediment to ruin the streambed.

- **Riffles**—These provide food and spawning areas for fish, and hunting areas for predators such as raccoons and bears.
- **Pools**—Resting areas and shelter are needed for fish to survive.
- **Streambed**—Area provides habitat for fish egg incubation.
- **Stream width/depth**—Narrow, deep streams increase available habitat for fish.
- **Water temperature**—A cooler temperature allows for more dissolved oxygen for fish.
- **Riparian area**—Area near riverbanks provides a breeding ground for insects used as food for fish.

Figure 7



b. Protecting river and stream habitats

- Fence to protect from livestock grazing and watering.
- Control erosion in the watershed to reduce silting into stream or river.
- Control streambank erosion by planting trees and shrubs and by placing rocks and stones along the edge.
- Remove debris lodged on inside curves of the stream that restrict water flow.
- Use deflectors to create natural pools.

Information Sheet

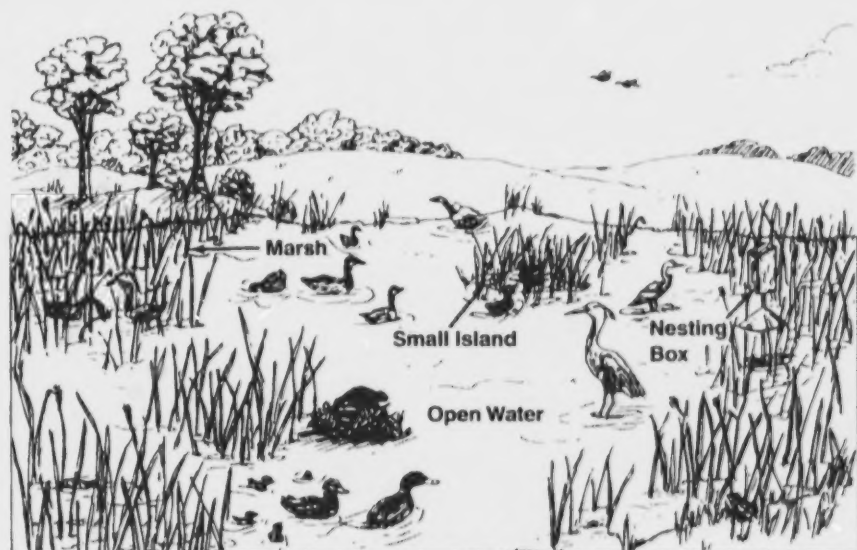
Objective 11

Wetland habitats

a. Components

- Potholes, playa lakes, and marsh—An ideal wetland is one-third open water and two-thirds marsh.
- Plant communities—The high concentration of nutrients in wetlands helps to increase the productivity of vegetation.
- Size—Larger wetland areas tend to provide more diverse habitat for more types of wildlife.
- The level of water usually fluctuates seasonally which will affect the type and number of wildlife at those times.

Figure 8



b. Protecting wetland habitats

- Provide a dependable water supply.
- Control water levels.
- Protect area from too much grazing that can destroy valuable food and cover.
- In wetlands that are overgrown, provide open areas by removing vegetation in 50-foot wide strips.

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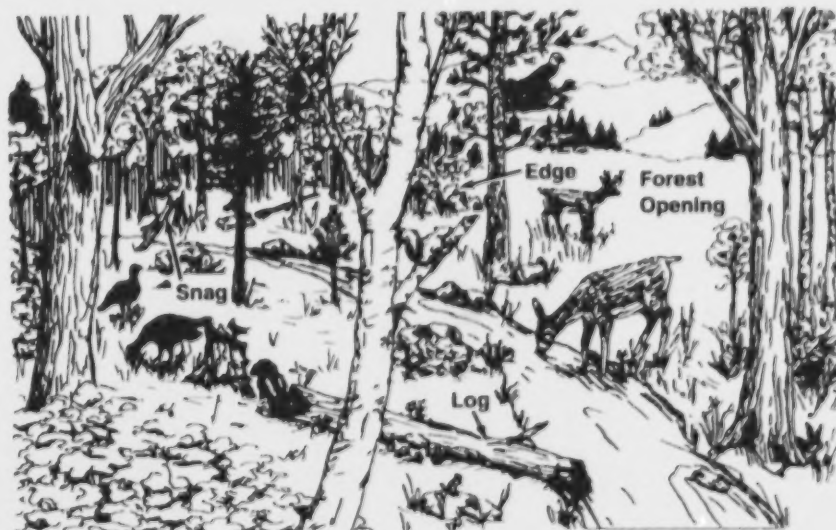
Objective 12

Woodland habitats

Key term:

- **Release cut**—Thinning of old shrub growth to allow new growth
 - a. Components
 - Trees—Deciduous and evergreen trees of various ages and sizes
 - Snags—Dead or partly dead trees
 - Logs—Dead trees or portions of trees lying on the forest floor
 - Edges—Preferred by large numbers of wildlife
 - Forest openings—Areas that do not support trees but provide a source of diversity within the forest

Figure 9



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Information Sheet

b. Protecting woodland habitats

- Protect from unwanted fire.

Note: Prescribed and controlled fires can aid in maintaining proper wildlife habitat by renewing forest growth and providing "edges" for numerous species' habitat.

- Protect from overgrazing.
- Selectively cut trees.
- Leave den trees when cutting hardwood timber.
- Pile brush near the edge of the woods.
- Release cut to increase production of nuts and other tree seeds useful to wildlife.
- Cut trees out of woodland edges to increase the growth of shrubs for food and cover.

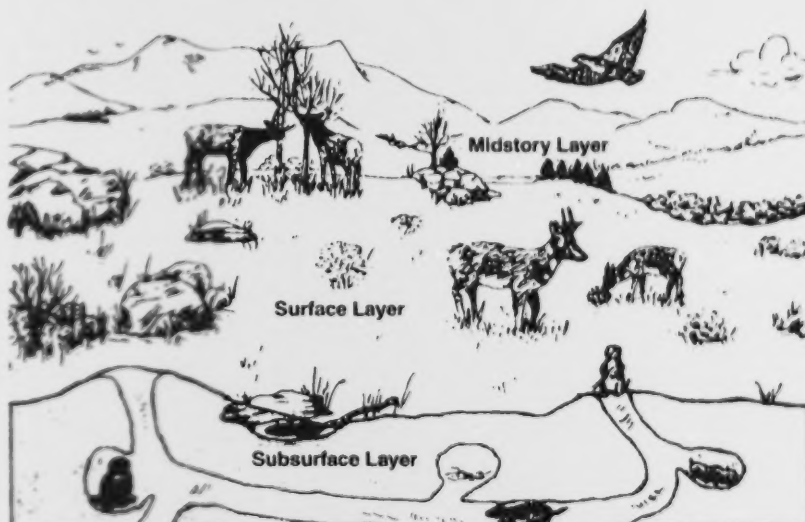
Objective 13

Rangeland habitats

a. Components

- **Subsurface layer**—Includes the area suitable for burrow or tunnel construction
- **Surface layer**—Includes short, mid, and tall grass species
- **Midstory layer**—Includes deciduous and evergreen shrubs

Figure 10



b. Protecting rangeland habitats

- Protect from unwanted fires.

Note: Prescribed burns help prevent succession to species such as red cedar, mesquite, shinnery oak, etc.

- Protect from overgrazing.
- Reseed and renovate grasses.
- Construct walkways in marshy rangeland.
- Remove only part of the brush and shrubs.
- Fertilize to increase plant growth.

Note: In native prairie areas, fertilizer will increase growth of forbs—to the detriment of native grass species which do not respond well to additional fertilizer.

- Provide areas for watering.
- Provide salt.

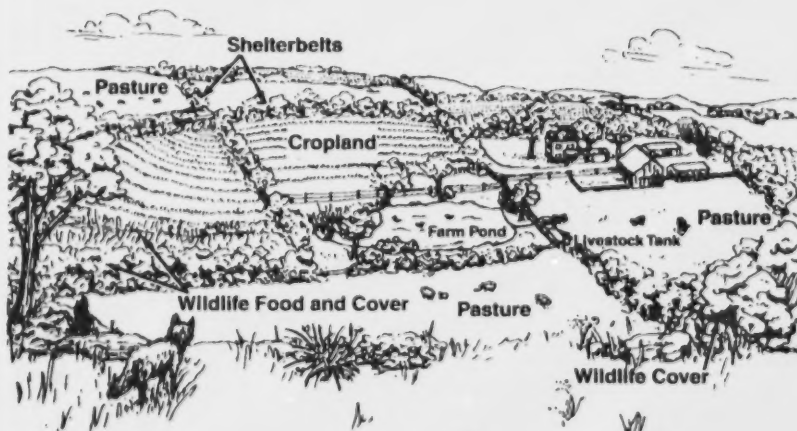
Objective 14

Farmland habitats

a. Components

- Cropland
- Pasture
- Shelterbelts

Figure 11



Information Sheet

Objective 15

b. Protecting farmland habitats

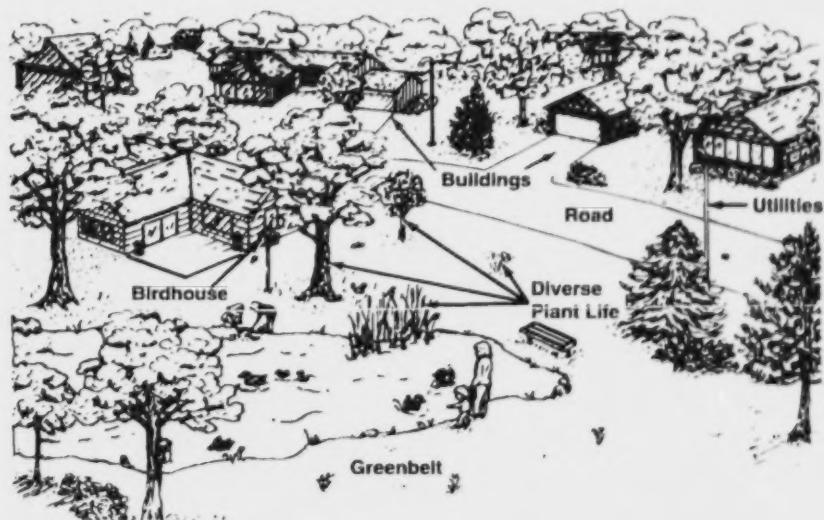
- Provide wildlife with habitat areas so they do not reduce crops meant for production.
- Protect wildlife areas from grazing by domestic animals.
- Plant trees and shrubs for cover and food.
- Maintain a source of water.
- Perform good land management practices that prevent soil erosion.
- Provide shelterbelts for erosion control and wildlife habitat.
- Seed marginal lands to grasses.
- Provide food or cover plots.
- Construct farm ponds.
- Control burning.
- Prevent overgrazing of pastures.
- Restrict clean mowing of pastures and fence rows.
- Evaluate removal of brush.

Urban habitats

a. Components

- Buildings
- Landscaped areas and lawns
- Utilities
- Transportation (roads and vehicles)
- Natural areas such as parks, greenbelts, and undeveloped areas
- People and pets

Figure 12



b. Protecting urban habitats

- Plant trees and shrubs of diverse species preferred by wildlife for food and cover, especially on edges of property.

Note: Plantings with greater diversity will attract more kinds of wildlife.

- Provide steady water sources at ground level.
- Use chemicals (fertilizers and pesticides) conservatively and according to label directions.
- Provide bird houses, feeders, and baths.
- Restrict free roaming pets.
- Use greenbelts (undisturbed areas) in new urban developments to provide areas for wildlife.

Student Supplement 1—List of Selected Wildlife Foods

Wildlife	Foods
Bass:	Fish, frogs and salamanders, turtles, snakes, crayfish, insects, earthworms, small mammals, spiders
Bats:	Insects
Beaver:	Bark, twigs and leaves, forbs (greens), aquatic plants (roots)
Bluebirds:	Seeds, fruit, insects
Bluegill:	Insects, earthworms, spiders
Butterflies:	Nectar from flowers
Deer:	Tender leaves and twigs, buds, nuts, lichens, ferns, forbs (greens), fruit, mushrooms, grain, grass, bark
Doves:	Grain, seeds
Ducks:	Nuts, grain, insects, seeds, aquatic plants (seeds, leaves, bulbs, and tubers), snails, crayfish, frogs, salamanders, earthworms, fish
Foxes:	Insects, deer carrion, birds, fruit, small mammals (rats, mice, and rabbits)
Frogs:	Insects, earthworms, spiders, crayfish, snails, other frogs, turtles, snakes
Grouse:	Leaves and twigs, buds, insects, seeds, forbs (greens)
Hawks:	Insects, frogs and salamanders, snakes, lizards, birds, crayfish, small mammals (rats, mice, rabbits, squirrels)
Lizards:	Insects, spiders, other lizards, snakes, scorpions, birds, eggs, snails, small mammals (mice)
Marten:	Small mammals, birds, insects, fruit, frogs, fish
Mink:	Small mammals, birds, fish, crayfish, insects
Moles:	Insects, earthworms, snails
Otter:	Fish, crayfish, birds, frogs, salamanders, mussels, small mammals
Owls:	Birds, insects, snakes, small mammals (mice, rats, rabbits, shrews, moles, opossums, foxes)
Pronghorn:	Leaves and twigs, buds, forbs (greens), grass, grain, seeds
Quail:	Forbs (greens), fruit, grain, insects, seeds, nuts, spiders
Rabbits:	Forbs (greens), fruit, bark, grain, buds, grass, leaves and twigs
Thrashers:	Seeds, insects, spiders, fruit
Trout:	Insects, snails, crayfish, small fish, earthworms, spiders
Turkeys:	Nuts, tubers, forbs (greens), seeds, insects, fruit, snails, centipedes and millipedes, grain, spiders, buds, grass
Turtles:	Aquatic plants, fruit, mussels, forbs (greens), fish, crayfish, insects, spiders, carrion

Student Supplement 1

Wildlife	Foods
Wapiti (Elk):	Grass, leaves and twigs, buds, forbs (greens), bark, mushrooms
Warblers:	Insects, spiders
Woodpeckers:	Insects, fruit, spiders, lizards, seeds, grain, frogs, nuts
Wrens:	Spiders, insects
Salamanders:	Earthworms, snails, insects, centipedes
Shrews:	Insects, snails, earthworms, salamanders
Snakes:	Insects, birds, eggs, other snakes, fish, frogs, earthworms, small mammals (mice, rats), turtles
Sparrows:	Insects, seeds, spiders, forbs (greens), buds, fruit
Squirrels:	Nuts, seeds, buds, mushrooms, fruit, grain

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Objective Sheet

Unit
Objective

After completing this unit, the student should be able to evaluate a local outdoor recreation site and plan and design an outdoor recreation area. The student should demonstrate these competencies by completing the assignment sheets and by scoring a minimum of 85 percent on the written test.

Specific
Objectives

After completing this unit, the student should be able to:

1. Match terms related to outdoor recreation with their definitions.
2. List the equipment and facilities needed for selected outdoor recreation activities.
3. State the skills and licenses needed for outdoor recreation activities.
4. Select from a list the major factors increasing the demand and participation in outdoor recreation.
5. Select true statements concerning other factors affecting current and future participation in recreational activities.
6. List considerations when selecting an outdoor recreation area.
7. List reasons why people participate in outdoor recreation.
8. Select from a list agencies responsible for public lands, recreation areas, and employment in outdoor recreation.
9. Match employment opportunities in outdoor recreation with their appropriate description.
10. Select from a list business opportunities in outdoor recreation.
11. Interpret graphs on future trends in outdoor recreation.
(Assignment Sheet 1)
12. Identify outdoor recreation activities and facilities available locally.
(Assignment Sheet 2)
13. Evaluate a local outdoor recreation site. (Assignment Sheet 3)
14. Make a presentation about an outdoor recreation activity.
(Assignment Sheet 4)
15. Plan and design a new outdoor recreation area. (Assignment Sheet 5)
16. Give accurate, easy-to-follow directions. (Assignment Sheet 6)
17. Evaluate conflict resolution scenarios. (Assignment Sheet 7)
18. Explore career opportunities in natural resources. (Assignment Sheet 8)

Information Sheet

Key term:

- **Outdoor recreation**—Deals with any activity that a person voluntarily does in the outdoors for enjoyment and satisfaction

Introduction

As our leisure time becomes greater and greater, the demand for recreation activities and facilities also increases. **Outdoor recreation** deals with any activity that a person voluntarily does in the outdoors for enjoyment and satisfaction.

Many people enjoy using natural resources for outdoor recreation. The fresh air, exercise, and appeal of the outdoors makes being outside enjoyable. The beauty of nature is appealing to many people. There are many things to see and do in the outdoors. We can enjoy the outdoors but not damage it. We can look, experience, and enjoy and leave it in unused condition for the next person.

Understanding the outdoors helps us enjoy being outside more. We know what to expect and how to be prepared. We can also enjoy it even when we cannot walk long distances or be active in hunting and fishing

The nature of outdoor recreation activities varies widely. Some activities are passive, meaning that people who do them do not exert much physical effort. Other outdoor activities require active physical participation. Examples of outdoor recreation include: water recreation, winter recreation, camping, birding, hiking, horseback riding, fishing, and hunting.

The use of natural resources may be consumptive or nonconsumptive. Consumptive use is taking or using a resource so it is no longer available. Examples are hunting, fishing, and other activities that remove the natural resource. Nonconsumptive use is using resources so they are not used up. Watching, photographing, skiing, hiking, camping, and other similar activities do not take natural resources.

Good users of natural resources for outdoor recreation try to avoid an impact that affects the quality of the resources. They respect the rights of other people. Full and safe enjoyment begins with planning outdoor recreational activities. Outdoor areas should always be left in good condition for the next user. You want to find an area in good condition when you use it. You should leave it that way for the next person. Be responsible for what you do.

Objective 1

Terms and definitions

Concessions

Cultural event

Disposable personal income (DPI)

Facility

Leisure

Life expectancy

Outdoor recreation

Scenic

Stress

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Information Sheet

Objective 2

Equipment and facilities needed for outdoor recreation activities

Activity	Equipment	Facility
Archery	Bows, arrows, proper clothing	Archery range, public or private hunting area
Biking	Bicycle, helmet	Bike trails, safety signs
Bird watching	Binoculars, camera, bird books	Natural habitats
Boating	Motor or sailboat	Lake or large river
Camping	Tent or trailer, cookware, lights, proper clothing	Table, grill, trash disposal, clean, scenic uncrowded area
Canoeing	Canoe, life jacket, paddles	Stream or lake
Fishing	Fishing pole, reel, bait	Lake, stream, or farm pond
Four-wheeling, ATV	Four-wheel-drive vehicle or other all-terrain vehicle	Rough or challenging terrain, dry stream beds
Golfing	Golf equipment	Golf course, driving range, or miniature golf course
Hang gliding	Hang glider	Steep terrain, dependable air currents
Hiking	Shoes, pack, food, maps	Hiking trails, scenic area
Horseback riding	Horse, riding gear (tack)	Barns, corrals, riding area
Hunting	Gun, ammunition, proper clothing	Private hunting area with permission or public hunting area
Jogging/walking	Proper shoes and clothing	Trails or tracks
Lawn games such as volleyball, badminton	Game equipment	Small open, uncrowded areas
Picnicking	Food, table	Shaded, scenic area, clean, free of pests
Rock/mountain climbing	Proper clothes, climbing equipment	Public/private climbing area
Scuba diving	Diving equipment, boat	Clear lake, ocean, or stream
Sight-seeing	Private vehicle or bus	Scenic turn-outs, information signs
Snow skiing	Skis, boots, proper clothing	Mountainous area, heavy snowfall
Surfing	Surfboard or sailboard	Coastal areas or lakes
Swimming	Life vest, "buddy"	Indoor or outdoor swimming area
Tennis	Tennis racquet, balls, shoes	Tennis court
Water skiing	Skis, boat, ski rope, life vest	Lake or large river

Information Sheet

Objective 3

Skills and licenses needed for outdoor recreation activities

Activity	Skills	License/Permit/Certification
Archery	Knowledge of equipment, safety	None
Biking	Biking techniques, safety	Bike license required in some states
Bird watching	Knowledge of species and habitats	None
Boating	Boat operation, safety	Boat, motor, trailer license
Camping	Tent pitching, fire building	Permits at some locations
Canoeing	Paddling, safety	Canoe license in some states
Fishing	Technique	Fishing license or permit
Four-wheeling, ATV	Performance capability, safety	License required in some states
Golfing	Technique	Usually a fee is required
Hang gliding	Coordination, safety	Certification from hang gliding school
Hiking	Map reading, physical fitness	None
Horseback riding	Saddling, caring for a horse, safety	None
Hunting	Knowledge of outdoors, safety	Hunting license
Jogging/walking	None	None
Lawn games such as volleyball, badminton	Various techniques	None
Picnicking	None	None
Rock/mountain climbing	Climbing techniques, safety	Certain areas require permits
Scuba diving	Swimming safety	Scuba diving certification
Sight-seeing	Map reading	None
Snow skiing	Balance, technique, endurance, safety	None, a fee may be required
Surfing	Balance, safety	None
Swimming	Swimming technique, safety	None, a fee may be required
Tennis	Balance, technique, endurance	None
Water skiing	Balance, technique, safety	None

Information Sheet

Objective 4

Major factors increasing the demand and participation in outdoor recreation

Key term:

- **Leisure**—Unoccupied time during which one may indulge in rest or recreation
 - a. **Leisure time**—As leisure time increases, participation in outdoor recreation increases.
 - b. **Income**—As individual income increases, the ability to pay for outdoor recreational equipment, area-use fees, transportation, and facility fees also increases.
 - c. **Mobility**—The ability of an individual to travel freely influences the participation in outdoor recreational activities. The automobile, available to most Americans, is the principal means of transportation to recreational destinations.

Objective 5

Other factors affecting current and future participation in recreational activities

Key terms:

- **Disposable personal income**—Income above what is needed to buy life's necessities
- **Life expectancy**—The average age at which people die
 - a. **Age**—More Americans are retiring at an earlier age. Less than 1 in 4 wait until age 65 to retire.
 - **Life expectancy** is increasing because of better health care and environmental conditions.
 - Early retirement and increased life expectancy increases leisure time for senior citizens resulting in a greater demand for outdoor recreation facilities.
 - b. **Disposable personal income (DPI)**—Has decreased in the past 20 years.

Note: Recently the share of DPI going to recreation was 6.4%.
 - c. **Physical disability**—56% of people with physical disabilities are limited by mobility which prevents their participation in outdoor recreation. As accommodations for the physically challenged improve, participation in outdoor recreation will follow.
 - d. **Women**—As more women join the work force, advance toward economic equity, and have more leisure time, they will be more active in outdoor recreation and will likely become leaders in recreational activity trends.

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Objective 6

Considerations when selecting an outdoor recreation area

Key terms:

- **Concessions**—The right to sell food, supplies, or equipment at a park or event
- **Cultural event**—Events or programs which train and refine the mind
- **Facility**—A structure or convenience which allows something to be done more easily or enjoyably
- **Scenic**—View or landscape having natural beauty

a. Natural beauty (An area with outstanding **scenic** qualities)

b. Amount of crowding

Note: Many people travel to recreational areas to get away from crowds.

c. Sanitation **facilities** (clean and convenient)

d. Parking availability

e. Available information (information centers, brochures, signs)

f. Picnic areas (clean and convenient)

g. **Cultural events**

h. User fees

Note: Fees are used primarily to improve facilities, but can be instrumental in reducing overcrowding.

i. **Concessions**

j. Organized sports or competitive events

k. Guided activities

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Information Sheet

Objective 7

Reasons why people participate in outdoor recreation

Key term:

- **Stress**—Tension, strain, or force exerted upon a body

Note: These are grouped to show percentage of composition.

Reason	Percentage
Fitness • To obtain or maintain good health from physical exercise • To enjoy fresh air and sunshine • To reduce stress • To lose weight	10%
Social • For relaxation with other people • To be with friends • To make friends • So the family can be together • To have fun	33%
Excitement • To break the monotony of daily routines • For competition in outdoor recreation activities • For excitement in doing unusual things • To experience the risk and danger involved • To develop new skills	16%
Experience self and nature • To be alone • To experience nature • To view the scenery • To test self endurance, limitations, and character • To watch wildlife	33%
Conformist • Because everyone else is doing it • To get away from a cramped environment	8%

Information Sheet

Objective 8

Agencies responsible for public lands, recreation areas, and employment in outdoor recreation

- a. U.S. National Park Service
- b. U.S. Forest Service
- c. U.S. Army Corps of Engineers
- d. U.S. Bureau of Reclamation
- e. U.S. Bureau of Land Management
- f. U.S. Fish and Wildlife Service
- g. State park services
- h. State recreation and tourism departments
- i. State fish and game departments
- j. Regional, county, and city parks
- k. Private recreational areas
- l. Private recreational businesses

Objective 9

Employment opportunities in outdoor recreation

- a. Business management—Managing a business
- b. Entertainment—As applied to outdoor recreation, this would be in the form of nature programs, outdoor plays, or musical entertainment
- c. Enforcement—As a park ranger, lake ranger, or game warden, conflict resolution
- d. Equipment operation—Truck drivers or operators of tractors, chain saws, lawn mowers, string trimmers, water pumps, and electric motors
- e. Ground care—Landscaping, grass trimming, camp site cleaning, trail building, and facility repair
- f. Guide service—Hunting or fishing guide, hiking guide, canoeing and rafting, horseback riding, and sight-seeing
- g. Instruction—Golf, hang gliding, scuba diving, surfing, wind surfing, swimming, tennis, snow and water skiing
- h. Recreation manager—Managing a recreational area or activity
- i. Rental—Paying for the use of recreational equipment
- j. Safety—The instruction of safety procedures or first aid

Information Sheet

Objective 10

- k. Sanitation—Maintaining the sanitary facilities such as garbage, restrooms, pest control, trailer dump facilities, and general cleanliness
- l. Wildlife management—Control and improvement of wildlife numbers

Business opportunities in outdoor recreation

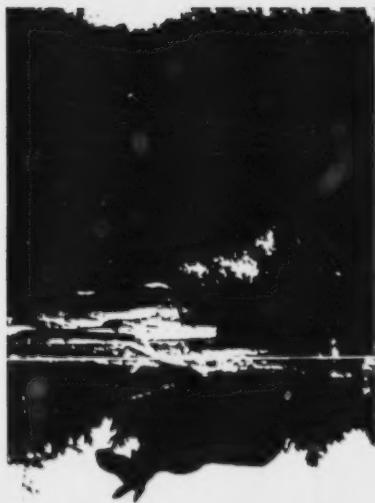
- a. Contractual
 - Grounds care
 - Landscaping
 - Sanitation
- b. Bait shop
- c. Dude ranch
- d. Equipment maintenance
- e. Equipment sales
- f. Fish farms
- g. Guide service
 - Hunting
 - Fishing
 - Hiking
 - Canoeing/rafting
 - Horseback riding/pack train
 - Rock/mountain climbing
 - Scuba diving
 - Sight-seeing
- h. Hunting preserve
- i. Instruction and sales
- j. Excursion boat
- k. R.V. campground
- l. Equipment rental
- m. Sporting good store
- n. Travel agent
- o. Youth camp

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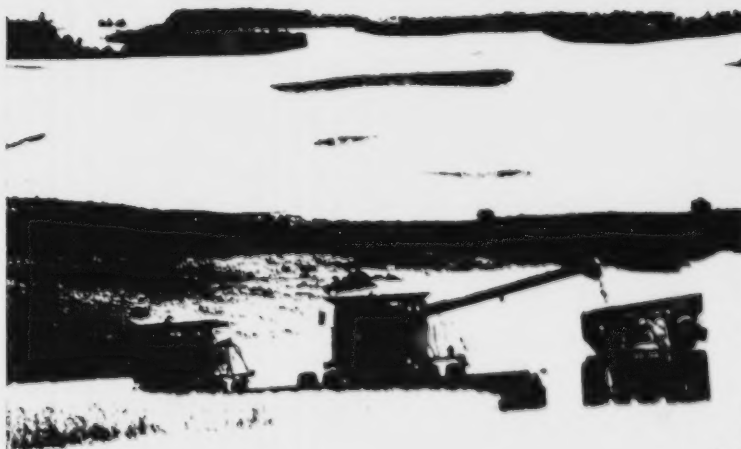
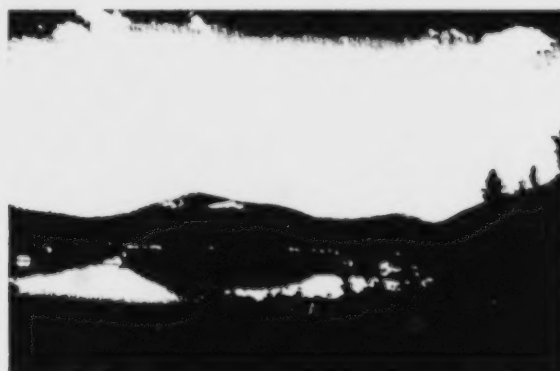
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Introduction to Natural Resources

Third Edition

Student Workbook



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Written by

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Unit 1

Outdoor Safety and First Aid

Objective 13

Assignment Sheet 1—Read Wind Chill Index and Water Survival Charts

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers are correct	_____

Basic Skills



Reading



Mathematics



Science

Introduction

As information in this unit has shown, survival in cold conditions becomes more difficult as temperatures drop and winds increase. This exercise will sharpen your chart reading skills and will reinforce the importance of taking precautions to protect yourself in cold conditions.

Directions

Read the following scenarios and answer the questions accompanying each according to the charts printed here.

Water Survival Chart		
If the Water Temp. (°F) is...	Exhaustion or Unconsciousness Occurs In...	Expected Time of Survival Is...
32.0	Under 15 Minutes	Under 15-45 Minutes
32.5-40.0	15-30 Minutes	30-90 Minutes
40-50	30-60 Minutes	1-3 Hours
50-60	1-2 Hours	1-6 Hours
60-70	2-7 Hours	2-40 Hours
70-80	3-12 Hours	3-Indefinitely
over 80	Indefinitely	

1. What is the expected time of survival of a human in the water if the water temperature is 57° F?

Assignment Sheet 1

2. Water temperatures at the sinking of the *Titanic* in 1912 were estimated to be about 32° F. How long do you think most victims survived in the icy waters around the sinking ship?

3. As the result of a night boating accident an individual is pitched into 45° F water. Although the victim is wearing a life preserver, unconsciousness from hypothermia can be expected to occur in _____ to _____ minutes.

Wind Chill Index												
Estimated Wind Speed in MPH	Actual Thermometer Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Temperature (°F)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-88
10	40	28	16	4	-9	-21	-38	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-36	-45	-58	-72	-88	-89	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-124
25	30	16	0	15	-29	-44	-59	-74	-83	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-107	-128	-140
35	27	11	-4	-20	-35	-49	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	Little Danger* (for properly clothed person)				Increasing Danger*				Great Danger*			
	*Danger From Freezing of Exposed Flesh											

4. If the actual thermometer reading is 50° F. and the wind is 30 miles per hour, what is the equivalent wind chill reading? _____
5. Given a winter afternoon temperature reading of 10° F. and north wind of 20 mph per hour, the equivalent wind chill reading is _____
6. The wind chill reading is -2° F. and the wind speed is 30 miles per hour. What is the actual thermometer reading? _____

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Unit 1

Outdoor Safety and First Aid

Objective 14

Assignment Sheet 2—Interpret Portable Fire-Extinguishing Symbols

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• All answers are correct	_____

Basic Skills



Reading



Employability

Introduction

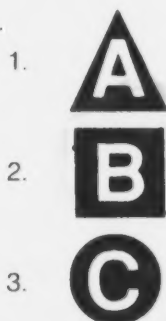
When a fire occurs, it is very important not only to be able to size-up and identify the type of fire, but also to choose an extinguisher that will be effective in putting out the fire.

Directions

Review the material presented in Objective 10 of the information sheet, and locate and study the information presented in Student Supplement 4.

Next, read and follow the directions with each item below.

- Match extinguisher picture symbols with the extinguisher's intended applications. Write the corresponding numbers in the blanks provided.



- Class A and B fires but not Class C fires
- Flammable liquids
- Class B and C fires but not Class A fires

Assignment Sheet 2

- _____ d. Ordinary combustibles
- _____ e. Class A fires but not Class B and C fires
- _____ f. Electrical equipment

2. Write on the blank the correct fire-class letter that would appear in the center of each of the following extinguisher symbol shapes. Beside each shape write the color associated with the shape.

_____ a.  _____

_____ b.  _____

_____ c.  _____

_____ d.  _____

3. Complete fire-extinguisher general operating instructions that follow the letters P-A-S-S.

- a. **P** _____
- b. **A** _____
- c. **S** _____
- d. **S** _____

Unit 1

Outdoor Safety and First Aid

Objective 15

Assignment Sheet 3—Analyze Scenarios to Determine Appropriate Safety and First-Aid Procedures

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers indicate cognitive grasp of unit information and critical thinking	_____

Basic Skills



Reading



Writing



Critical Thinking

Introduction

Clear thinking and basic first-aid training are essential to successfully administer helpful assistance to an accident or trauma victim. As you learned from Student Supplement 1, there is a systematic approach to dealing with first-aid emergencies. In this exercise, you will evaluate various scenarios to determine the proper course of action, or to critique the actions taken based on what you have learned from the information in this unit of instruction.

Directions

Read the following scenarios and answer the questions accompanying each.

1. As a member of a construction crew working to develop a riverside rest area for rafters, you return from lunch to find one of your co-workers slumped against a gasoline trenching machine. The machine is still running, its trenching boom deep in a ditch near the restroom complex. Your friend seems to be unconscious. Based on a systematic look at first aid what is the first thing you should do?

Assignment Sheet 3

2. While fishing at a remote high mountain lake you hear a scraping clattering sound on the rocks behind you. As you turn to investigate, you see a bicyclist obviously out of control, falling head over heels down the mountain side from the trail above. She bounces off one last boulder and lands face down in the water at the edge of the lake. She doesn't move. Although you know her neck might be broken, you can't take a chance on her drowning so you carefully pull her from the water and turn her over to take a closer look. In order, what are the first three things you should determine?

a. _____

b. _____

c. _____

3. Julio and Brett are cataloging various native grasses and forbs on the Rita Blanca National Grasslands in far northwestern Oklahoma on a windy late May afternoon. They have walked nearly a mile from their pickup truck and are engrossed in photographing various specimens of buffalograss and occasional Little bluestem clumps when a lightning bolt from a rapidly approaching thunderstorm strikes a few hundred yards away with a deafening BOOM and a flash of heat. The Rita Blanca is open country with no trees and only occasional outcroppings of volcanic rock and few ravines. Evaluate this situation, giving suggestions on how Julio and Brett might have avoided their situation and what actions they might take to reduce their chance of being struck by lightning.

Assignment Sheet 3

4. As a newly assigned game ranger, you drive out of town to the end of a nearby reservoir on a sunny pre-duck-season afternoon in December. Although wintry conditions have prevailed for the past month or so, the temperature is relatively warm and you think it might be a good day to watch arriving mallard and pintail ducks as they migrate to the south. It would be a good way to spend your first day off in two weeks—just sitting, drinking from a Thermos bottle of coffee and watching the ducks announce the arrival of winter. Sitting in your pickup on a hill above a neck of the lake where much timber remains in the water, you notice a lone late-season fisherman standing up in his small boat to untangle a fishing line caught in a branch. Suddenly, he falls backward into the 40 degree water. You know he has less than an hour to live if he doesn't get out of the water, so you race your truck across the pastureland to try to give him assistance. Once you arrive at lakeside, you realize the man is wearing a personal flotation device and is awkwardly swimming through the tangles of brush and limbs to shore. As you toss a rope out to him, he grasps at it eagerly and thrashes in the water for several seconds before grabbing it...allowing you to pull him ashore. As he stands in the mud gasping for air, he thanks you profusely and complains of cramping cold muscles. He tries in vain to take off his life vest and begins to shake clumsily as you help him toward your pickup truck. Evaluate this man's condition and suggest several steps that can be taken at the scene to help him recover.

5. On a spring-break picnic Jeanette, Stacey, and Nolini were enjoying the sun, eating hot dogs and potato chips and taking a break from mid-term exams and the rigors of school. In their excitement and laughter, Nolini looked on in horror to see Stacey grabbing her throat, red-faced, and struggling. Immediately Jeanette raced to Stacey and performed the Heimlich maneuver several times until a chunk of frankfurter was dislodged from her throat. Describe the Heimlich maneuver and how it is performed.

Assignment Sheet 3

6. While hiking alone across a rocky hillside on a sunny late-fall afternoon in south Texas, LeRhonda rounded a bend in the trail and was terrified to see a large diamond-back rattlesnake sunning itself on a waist-high rock only a few feet in front of her. In her surprise, she lost her footing and fell down a cactus-filled rocky embankment. After the initial pain of cuts and bruises and the fear of falling had subsided, LeRhonda realized the sharp pain in her shin was probably the result of a broken leg. Climbing back to the trail was impossible in her condition and night was near, so she removed a nylon windbreaker from her backpack and put it on. She took a drink from her canteen and decided to make the best of it until someone came along the trail above, or she could get herself out of the predicament. The next morning, when two hikers found LeRhonda they found it difficult to communicate with her about what happened because of her incoherent speech patterns and her inability to speak without gasping. It was evident she had vomited several times throughout the night and she was extremely thirsty. In helping her drink, one of her rescuers noticed she felt cold and her pulse was rapid. Evaluate LeRhonda's condition and describe what actions should be taken immediately.

7. As an outdoor recreation instructor for a private youth summer camp in central Tennessee, you have been assigned to lead a day-long nature hike for a group of early teens. The route involves paths through stands of hardwood timber, along lake shores and up steep forested paths to panoramic hill tops. You have explained the possibility of encounters with various poisonous plants and the remote, but real, possibility of encounters with poisonous snakes. As you lead your group across the quiet, damp, leaf-littered forest floor, a boy in the back of the group steps over a log and yells as a sharp pain strikes the calf of his leg. "Snake!", he cries, as he hustles back to the group, limping and clutching his leg. You assemble the others and comfort the boy on a clearing near the path. He describes to you a burning sensation on the back of his leg and says he saw a glimpse of a brownish snake, almost the same color as the fallen leaves, crawling to safety beneath the log. Inspecting the boy's leg you find two distinct fang marks in the middle of the calf muscle. Evaluate this situation (what type of snake do you suspect was encountered, and describe appropriate first-aid measures you would apply.)

Assignment Sheet 3

8. After cooking breakfast over a small open fire at your campsite near a stream in a national forest, you are ready to pack your gear and resume your weeklong hiking vacation. Using your knowledge of the fire triangle, what will you do with the campfire to ensure it will not become a problem after you leave?

9. As a member of a contract crew renovating a playground, you find yourself assigned the task of planting grass on bare spots left by years of hard play. Part of the process involves applying ammonium nitrate fertilizer to the areas to give the new grass adequate fertility to cover the area quickly. You are not familiar with ammonium nitrate and you're not really certain what it is or what hazards it might represent. Where can you get more information about the substance before you begin handling it?

10. As an employee of a recycling business, you are operating a baling machine that compresses scrap paper into 500-pound square bales for shipping. You become aware of a smoky smell drifting through your workplace. Upon investigating further, you find a carelessly discarded cigarette has caused a bin of scrap newsprint to catch fire. With your knowledge of the different types of fire extinguishers and fires, describe the classification of this fire, and what type of fire extinguisher should be readily available to fight it.

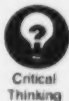
Objective 16

Assignment Sheet 4—Interpret Material Safety Data Sheets

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Ability to read and interpret data is evident from student's answers	_____

Basic Skills**Introduction**

It is important not only that all employees have access to MSDS report forms, but also that all employees know how to read and interpret the data on those forms.

Directions

Review the material in Objective 11 of the information sheet, and locate and study the information presented in Student Supplement 6, "Guidelines for Interpreting Material Safety Data Sheets."

Next, locate and study the MSDSs presented in Student Supplement 7, "Sample MSDSs." Use the MSDSs in Student Supplement 7 to answer the following questions. Write your answers on the blanks provided below each item.

The MSDSs supplied concern a popular fertilizer, an engine coolant found in vehicles and outdoor equipment, and a popular insecticide and a herbicide used in pasture and rangeland renovation activities.

MSDS 1—Cato Coolant (A typical antifreeze/coolant)

1. What is the main ingredient of this product?

2. What is the appearance of this product?

Assignment Sheet 4

3. What emergency telephone numbers should one call for problems with this product?

4. To what temperature must this product be raised before it will ignite?

5. What type of fire extinguisher may be used on a fire involving this material?

6. What hazardous materials can the incomplete combustion of this product cause?

7. What effects can this product have if its fumes are inhaled?

8. How may this product affect the skin?

9. What may happen if this product is ingested?

10. In concentrations of up to 500 parts per million, what respiratory protection is needed with this product?

MSDS 2—Sevin 5% Dust (Common garden, lawn, and agricultural insecticide)

1. What is the main ingredient of this product?

2. What is the appearance of this product?

3. What type of fire extinguisher may be used to combat fires involving this material?

Assignment Sheet 4

4. What health hazards to the eyes might contact with this material cause?

5. What may happen if this product is ingested?

6. What symptoms may occur if this product is ingested?

7. What respiratory protection is needed while handling this product?

8. What skin protection is needed while handling this product?

9. What first-aid measure should be taken immediately for a victim of inhalation of this product?

10. What emergency telephone number is to be used for problems with this product?

MSDS 3—Ammonium Nitrate (Common lawn and agricultural fertilizer)

1. What is the principal hazardous substance in this product?

2. What emergency telephone number is to be used for problems with this product?

3. What appearance does this product have?

4. What is the recommended fire extinguishing agent recommended for fires involving this product?

Assignment Sheet 4

5. What harmful compounds are released when this product burns?

6. What symptoms of acute exposure might be apparent if this product is ingested?

7. What may happen if this product is inhaled?

8. What affect does this product have on the skin?

9. What type of respiratory protection is needed while handling this product?

10. What other protective clothing is needed to handle this material?

MSDS 4—Atrazine 4L (Brand name AATREX; common herbicide used in pasture and range renovation)

1. What emergency assistance telephone numbers should be used for problems with this product?

2. What is the main technical ingredient of this product?

3. In addition to the main technical ingredient, what other compound does this material contain (Component 2)?

4. What may happen if this material is splashed into the eye?

5. What effect does this material have on the skin?

Assignment Sheet 4

6. What organs of the body might be severely affected if this product is ingested?

7. What emergency first aid should be administered to a victim whose eyes have come in contact with this material?

8. What first aid action is required for a victim who has inhaled this product and has difficulty breathing?

9. At what temperature will this product burn?

10. What unusual fire and explosion hazards might be released upon combustion?

Objective 17

Assignment Sheet 5—Analyze Current Reports Concerning Outdoor Safety and First Aid

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Minimum of five current articles collected	_____
• Content is relevant and well organized	_____
• Report is neat and legible	_____

Basic Skills



Reading



Writing

Critical
Thinking

Introduction

Throughout this study of natural resources, you will be asked to research and report on a variety of subjects according to material being covered in the specific units of instruction you are studying. In this assignment you will be researching material relevant to outdoor safety subjects.

Directions

Each day, newspapers, and weekly and monthly magazines, trade journals and scientific journals carry material related to health, safety, first aid, and various hazards. From these publications you are to collect a minimum of five current (within the past three years) articles dealing with areas of outdoor safety and first aid.

Summarize each of these articles, and write a report in which you analyze the content of the articles. Subject matter can vary, but examples might include: the controversy over first aid and secondary treatment of venomous snake bites; the application of cold or hot packs to sprains and fractures; the risks of mouth-to-mouth resuscitation in an era of concern over disease.

Your instructor will provide you with guidelines explaining the format of the finished report. This assignment will be collected and retained in a portfolio that will become a record of the progress you have made in your study of natural resources.

Note: For help in finding recent periodicals concerning outdoor safety and natural resources, consult the *Reader's Guide* in your school or community library.

Objective 18

**Job Sheet 1—Demonstrate the Heimlich Maneuver
for an Adult Choking Victim**

Name _____ Attempt Number _____

Date _____ Overall Rating _____

Evaluation Criteria	Rating
• Procedure was performed at proper speed	_____
• Hands were positioned accurately	_____
• Procedure was performed smoothly (performed from memory)	_____

Basic Skills**Introduction**

A foreign body or obstruction of a person's airway usually occurs during a meal, with meat the most common cause of choking. Other factors that contribute to choking incidents are:

- Drinking excessive amounts of alcohol before and during a meal,
- Trying to eat large pieces of food, particularly if the individual wears dentures, and
- Talking and laughing with the mouth full.

A victim with complete obstruction of the airway cannot talk or cough and usually grasps his or her throat in a universal reaction to choking. A victim suffering partial obstruction may be coughing, choking, wheezing, turning blue, or exhibiting a combination of these symptoms as well as displaying the universal distress signal.

Instructions

When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the evaluation criteria.

**Tools,
Equipment,
and Materials**

- CPR dummy

Caution: Do not perform this maneuver on a fellow student or co-worker. Injury may result. Use a CPR dummy for practice.

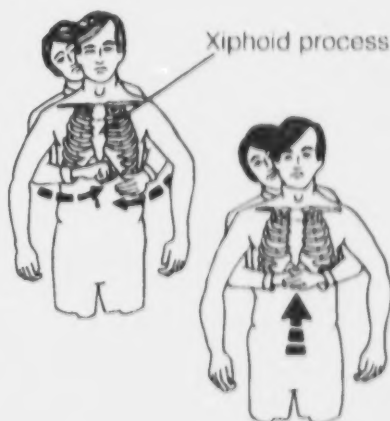
Job Sheet 1

Procedure

- ☐ 1. Ask, "Are you choking?"
- ☐ 2. If the victim can speak or is coughing, stand back and allow the victim to continue to try to dislodge the obstruction.
- ☐ 3. If the victim cannot cough or speak, apply the Heimlich maneuver to dislodge the object obstructing the airway.
 - ☐ a. Stand behind a standing or sitting "victim" (CPR dummy), and wrap your arms around the victim's waist.
 - ☐ b. Make a fist with one hand, and place the thumb side of your fist against the victim's abdomen, slightly above the navel and well below the xiphoid process (Figure 1)

Caution: Correct hand position is very important. Compressing the xiphoid process can result in broken ribs that can lacerate the lungs or other internal organs.

Figure 1



From Fire Service First Responder published by Fire Protection Publications. Copyright © 1987 by the Board of Regents, Oklahoma State University. All rights reserved.

- ☐ c. Grasp your fist with your other hand, and press the fist into the victim's abdomen 6 to 10 times with quick, inward and upward thrusts.

Note: Each thrust should be delivered with the intent of releasing the airway obstruction.

Evaluator's Comments: _____

Objective 19

Job Sheet 2—Lift a Heavy Object Properly

Name _____ Attempt Number _____

Date _____ Overall Rating _____

Evaluation Criteria

Rating

- Load was safely lifted _____
- Load was safely carried and set down _____

Basic Skills



Reading



Critical Thinking

Introduction

The number-one worker injury in America today is back strain or injury. Most of these injuries come from trying to lift an object that is too heavy or from lifting an object improperly. It is very important, therefore, that you learn to assess the weight of a load to be lifted, and either get help to lift the load or lift the load properly, using your leg muscles, not your back.

Instructions

When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the evaluation criteria.

Tools, Equipment, and Materials

- Large, heavy box
- Gloves
- Lower-back support belt

Procedure

- ☐ 1. Put on gloves and lower-back support belt.
- ☐ 2. Size up the load.
- ☐ 3. Place your feet close to the object and 8 to 12 inches apart for good balance.
- ☐ 4. Bend your knees to a degree that is comfortable.
- ☐ 5. Grip the box firmly with both hands.
- ☐ 6. Keeping your back straight and using your leg muscles, lift the box to waist height and hold close to your body.

Caution: Do not make any turning or twisting motions until the lift is complete.

Job Sheet 2

- ☐ 7. Turn by changing foot position, making sure that your path is clear.
- ☐ 8. Carry the box to the new location, using a normal walking gait and keeping your view unobstructed.
- ☐ 9. Reverse the lifting procedure to set the box down, taking care to bend your knees, keeping your back straight, and avoid setting the box on your fingers or feet.

Evaluator's Comments: _____

Unit 2

Natural Resources and Conservation

Objective 20

Assignment Sheet 1—Report on a Current Event Affecting Natural Resources

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Event selected is appropriate	_____
• Subject is covered well	_____
• Presentation is informative	_____

Basic Skills



Reading



Science



Oral Communication



Critical Thinking

Introduction

Some of the best ways to stay informed about the world and what is going on around us is to read local, state, and national newspapers (*USA Today*) and news magazines such as *U.S. News and World Report*, *Time*, and *Newsweek*. Articles about natural occurrences or other factors that affect the earth and our environment often appear in these as well as other publications. Floods, fires, earthquakes, oil spills, toxic chemical spills, and waste disposal are just some of the reported events that affect natural resources. By becoming aware of these problems and studying the impact on our environment, we can help find solutions to these problems and protect our natural resources.

Directions

Select a current event such as a forest fire, flood, earthquake, etc. and collect current newspaper and magazine articles which discuss this event and how it is affecting natural resources. Analyze the problem and evaluate the solution. Think of other solutions that might be more effective. Then, prepare a five-minute oral presentation on the subject. Answer the following questions in your report:

- What natural resources are being affected?
- How are they being affected? (the problem)
- What is being done about it? (the solution)
- Is the solution effective? Why or who not?
- What other solutions might be more effective?

Practice for your presentation.

Unit 2

Natural Resources and Conservation

Objective 21

Assignment Sheet 2—Report on a Local Natural Resource Problem

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Problem selected is appropriate	_____
• Report is thorough	_____
• Report is accurate	_____
• Report is neat and legible	_____

Basic Skills



Reading



Writing



Science



Critical
Thinking

Introduction

Proper management of natural resources is critical to the health, prosperity, and lifestyle of the people who use them. Since we are all consumers of natural resources, it is our responsibility to protect and conserve these resources for future use.

Directions

Select a problem which is adversely impacting natural resources in your community or area. Research the problem, and then write a report containing the following information:

- Name of impacting factor (problem)

Examples: Air pollution, water pollution, soil erosion, wildlife
/habitat depletion, and solid waste

Note: More than one factor may be used since they may act together. For example, soil erosion may cause muddy streams which affect fish species and production.

- Cause of impacting factor
- How it is affecting natural resources
- Solution to the problem
- Expected result if implemented

The report should adequately cover the subject. Length may be specified by the instructor.

Unit 2

Natural Resources and Conservation

Objective 22

Assignment Sheet 3—Identify Recycling Centers In Your Area

Name _____ Overall Rating _____

Date _____

Evaluation Criteria

Rating

- Assignment is neat _____
- Assignment was completed on time _____
- Centers are listed _____
- Products for recycling are listed _____

Basic Skills



Reading



Writing



Science

Introduction

Many recyclable materials can be found in the average household. Newspapers, plastic milk and soft drink bottles, glass bottles and jars, and aluminum cans are some examples. If consumers would take the time to separate their garbage and take the recyclable materials to their nearest recycling center or pickup area, as much as half of what we discard could be recycled. And some recyclable materials such as newspaper and aluminum are often collected by groups as a fundraising project and sold to recycling centers.

This assignment will help you become familiar with the locations of the recycling centers in your community and the products that are accepted for recycling.

Directions

Use the telephone book to make a list of recycling centers in your area. Call or visit them to determine the types of products that they recycle.

Recycling Centers	Products for Recycling
1.	
2.	
3.	
4.	
5.	

Unit 2

Natural Resources and Conservation

Objective 23

Assignment Sheet 4—Trace Route of Recyclable Products

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• All questions were answered	_____
• Final project report was thorough and well written	_____

Basic Skills



Reading



Writing



Science



Oral
Communication



Critical
Thinking

Introduction

Throughout this unit the importance of recycling and wise use of natural resources has been emphasized. Many products are readily reusable and many communities have adopted recycling programs which provide centrally located sites for accumulating recyclable materials. But, what happens to those products? In this exercise class members will be assigned various recyclable products to research to trace their paths from the original use, through the recycling point and on to remanufacturing and their final market as a recycled product.

Your instructor will assign a recycled product to be researched. For instance: used motor oil and engine antifreeze/coolant; cardboard and paper; plastic milk and soft drink containers; glass; aluminum cans and structural aluminum; copper; used batteries, etc. You will be responsible for tracking the assigned product from original use through the recycling site to a reprocessor and on its next use as a recycled product.

Directions

Seek information from managers of recycling sites. Other sources of information might include local retail outlets selling recycled products such as Wal-Mart, K-Mart, and others who sell recycled motor oil, batteries, etc. In addition, school and community libraries contain recent periodicals which feature material on recycling in the U.S. and what products are being developed from current waste material. Also you may want to research available websites for your area.

Using the above resources, and investigative skills of your own, use the following list of questions to track the route of a recycled product assigned to you through the recycling process.

Assignment Sheet 4

1. What uses has this product served before it came to the recycling center.

2. What processes will this product go through before it is sold to a remanufacturer? (Re-refining, crushing, melting, etc.)

3. How large a quantity of this product will be assembled before shipping to remanufacturer? (i.e., aluminum cans are sometime crushed into 40 lb. cubes for shipping)

4. Who is the purchaser of this recyclable material?

5. What does the purchaser do with the materials? (Is it directly turned into a new product? Is it processed further before being sold again? Some used motor oils are merely used for boiler fuel, while others are re-refined into high grade American Petroleum Institute rated motor oil.)

6. How much time elapses before this recyclable product is again on the market for use as a recycled product? (Aluminum from recycled cans can be on the shelf holding beverages again in a matter of days.)

7. What products available locally might contain this recycled material within a short time?

Assignment Sheet 4

8. How does the cost of this recycled material as a raw material compare with the cost of new material? (i.e., Cost of recycled paper fiber for a finished project compared with the cost of using new wood pulp fibers for the same product.)

9. How does the accumulator of this recyclable product secure sufficient quantities of the product to stay in business? (Advertising, word of mouth, contract waste removal?)

10. What is the public response for recycling this product...both for recycling the waste and purchasing the new product from recycled material?

Based on your investigation and outside reading, write a report tracing the flow of the recycled material you were assigned from your community to a reprocessor and on to consumers as a new product made from recycled material. Your instructor will provide you with guidelines explaining the format of the finished report.

Unit 2

Natural Resources and Conservation

Objective 24

Assignment Sheet 5—Identify Occupations in Natural Resources in Your Area

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Occupations listed are in natural resources	_____
• Explanation is logical	_____
• Assignment was completed on time	_____
• Assignment is neat and legible	_____

Basic Skills



Introduction

As you learned in Objective 17, there are many types of occupations in or related to natural resources. For individuals who enjoy working outdoors and interacting with the natural environment, a career in natural resources may be desirable.

This assignment will help familiarize you with career opportunities in your area.

Directions

Contact the local Chamber of Commerce, use the phone directory, visit with the school guidance counselor, and/or use materials furnished by the instructor to identify occupations in or related to natural resources in your area. List those occupations of interest to you and briefly explain why you think you might like that type of work.

1. Occupation: _____

Why do you think you might like this type of work?

2. Occupation: _____

Why do you think you might like this type of work?

Assignment Sheet 5

3. Occupation: _____

Why do you think you might like this type of work?

4. Occupation: _____

Why do you think you might like this type of work?

5. Occupation: _____

Why do you think you might like this type of work?

Unit 3**Water Resource Management****Objective 16****Assignment Sheet 1—Evaluate Your Source of Drinking Water**

Name _____ Overall Rating _____

Date _____

Evaluation Criteria**Rating**

- Information is accurate
- Potential sources of contamination are realistic.
- Explanation of safety of drinking water is logical.
- Assignment was completed on time.
- Assignment is neat and legible

Basic Skills

Reading



Writing



Science



Critical Thinking

Introduction

In the United States, people take it for granted that when they want a glass of water to drink all they have to do is turn on the faucet. This is not true in many parts of the world because proper treatment facilities are not available to purify water from rivers and streams. And, there are no laws to control waste disposal and to protect the water resources. As a result, disease such as cholera and dysentery are common in undeveloped countries, and the only safe drinking water comes from bottled water.

Directions

Answer the following questions.

1. Where does your drinking water come from:

a. At home: _____

b. At school: _____

2. Is your drinking water treated? (Circle the appropriate response)

a. At home: Yes No

If yes, how is it treated? _____

b. At school: Yes No

If yes, how is it treated? _____

Assignment Sheet 1

3. How often is your drinking water tested?
 - a. At home: _____
 - b. At school: _____
4. What did the last test of your drinking water show?
 - a. At home: _____

 - b. At school: _____

5. What are the potential sources of contamination to your drinking water?
 - a. At home: _____

 - b. At school: _____

6. In your own opinion, is the water you drink safe? (Circle the appropriate response)
 - a. At home: Yes No
Explain: _____

 - b. At school: Yes No
Explain: _____

Objective 17

Assignment Sheet 2—Survey Your Area to Identify Water Pollution Sources

Name _____ Overall Rating _____

Date _____

Evaluation Criteria**Rating**

- Identified at least two possible sources for area _____
- Explanation of problems is logical _____
- Assignment was completed on time _____
- Assignment is neat and legible _____

Basic Skills

Reading



Writing



Science



Critical Thinking

Introduction

Federal, state, and local agencies and policies exist to protect our water resources. These agencies along with environmental/water groups and concerned citizens have made significant progress in restoring water quality.

This assignment will provide you with an opportunity to learn about possible or real sources of water pollution in or around your community that may be causing environmental problems.

Directions

Survey possible or real sources of water pollution in your area. List at least two potential or real sources and explain whether or not each source is causing water pollution.

1. Source or Potential Source of Water Pollution: _____

Explanation: _____

Assignment Sheet 2

2. Source or Potential Source of Water Pollution: _____

Explanation: _____

3. Source or Potential Source of Water Pollution: _____

Explanation: _____

Unit 3

Water Resource Management

Objective 18

Assignment Sheet 3—Determine Ways to Reduce Home Water Consumption

Name _____ Overall Rating _____

Date _____

Evaluation Criteria

Rating

- Daily use chart was completed. _____
- Total water used per day and per week was calculated. _____
- Assignment is neat. _____
- Suggestions on ways to save water show thoughtful consideration and judgement. _____
- Assignment was completed on time. _____

Basic Skills



Reading



Writing



Mathematics



Science



Critical Thinking

Introduction

The typical American family uses an average between 150 to 200 gallons of water per day (90 gallons per person) in household consumption. In this exercise, you will be asked to record your own uses of water and make suggestions of how you would significantly reduce the amount of water you use individually.

Directions

Using information in the record usage chart and Student Supplements 1 and 2, consider your (or your family's) personal habits and routines as they apply to water uses and make suggestion on ways you can save water.

1. Observe your (or your family's) household water consumption for one day. Record your (or your family's) estimated household water consumption on the following worksheet.
2. Determine the estimated amount of water used per day and per week for each water use activity. Record on the worksheet.

Example: Your family of four each brushed their teeth once during the day. Each person took two minutes (with the water running) to brush their teeth.

Times/day (4) times two minutes each = 8 minutes.

8 minutes times 2 gallons/minute = 16 gallons per day.

16 gallons/day times 7 days = 112 gallons per week.

3. Determine the total amount of water used per day and per week. Record on the "total used line" for day and week on the worksheet.

Assignment Sheet 3

4. Suggest two ways you could significantly reduce the amount of water you or your family use.

1) _____

2) _____

Assignment Sheet 3

You Your Family (Circle one)

Date observed: _____

Water Use Activity	Times Per Day	Amount Used		Total Used	
		Estimated Gallons	Measured Gallons	Per Day	Per Week
Brushing Teeth		2 gallons/minute			
Showers		5 gallons/minute			
Bath		35 gallons			
Toilet		5 gallons/flush			
Food preparation		Measure the amounts			
Laundry		40 gallons/load			
Dishwasher		20 gallons/load			
Washing car		30 gallons/car			
Watering lawn		100 gallons/hour			
Getting a drink		.25 gallons			
Washing hands or face		5 gallons			
Other:					
Other:					
Total Water Used					

Helpful hints to determine other estimated amounts on activities not listed:

8 oz. = one cup

4 cups = a quart or 32 oz.

4 quarts = a gallon or 128 oz.

Unit 3

Water Resource Management

Objective 19

Assignment Sheet 4—Calculate the Cost of Water

Name _____ Overall Rating _____

Date _____

Evaluation Criteria

Rating

- Answers are correct _____
- Assignment was completed on time _____

Basic Skills



Reading



Mathematics

Introduction

Where municipal and rural water systems provide safe, clean drinking water at the turn of a faucet, most consumers pay little thought to the cost of water. Still, purchasing water, filtering and treating it to federal standards, and maintaining its distribution system involves expenses which must be borne by water consumers. This exercise will give you some idea of the cost of water provided by a rural water system to a household of four.

Directions

Read and answer the following questions based on the accompanying water bill.

RURAL WATER CORP. #3
202 S RANGE RD
STILLWATER, OK 74075

ACCOUNT	BILLING DATE		DUE DATE	
5512	04/30/03		05/15/03	
SERVICE	PRESENT	PREVIOUS	USE	CHARGES
Water	1665324	1648661	16663	64.29
Other Chgs				0.00
Late Fee				0.00
Credit				0.00
Previous Balance				0.00

Please pay by the 15th
Disconnect if not paid by 1st
of following month
(555)551-4064

AMT. DUE
64.29
AFTER DUE DT.
67.50

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Assignment Sheet 4

1. What is the present meter reading reflected on this bill?

2. What is the previous meter reading reflected on this bill?

3. Using the present meter reading and the previous meter reading, is the "use" figure reflected on this bill correct? (Circle the correct response.)

YesNo
4. Because a water meter measures actual gallons passing through it, use the "use" figure and the total charges for this month's bill to determine how much per gallon this rural water system customer is charged. (Note: Round answer to four decimal places.)

5. Using the answer you calculated in question 4, select and circle the answer from the following choices that most closely estimates the number of gallons one penny would buy from this rural water system.
 - a. 10 gallons
 - b. 100 gallons
 - c. 33 gallons
 - d. 2.5 gallons
6. Using a water bill from a local water distribution system in your area, determine how much a customer is charged per gallon of water.

Unit 3

Water Resource Management

Objective 20

Assignment Sheet 5—Calculate and Draw Conclusion from Water Measurements

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Calculations are correct.	_____
• Conclusion shows thoughtful consideration and judgment.	_____
• Assignment was completed on time.	_____

Basic Skills



Reading



Mathematics



Science



Critical Thinking

Introduction

This exercise is designed to give you practice in calculating water flows and volumes. It is also designed to acquaint you with the minute quantities of pollutants in relation to the water, air, or land around them.

- A. If you ever watch the weather on television, you may remember that part of the weather report includes the total amount of rainfall for the current month, and that number is often compared to the average rainfall per month for that area. This information gives farmers and gardeners an idea as to water distribution per acre from rainfall.

In this assignment you will determine the gallons per acre based on annual rainfall in your area.

Directions

Calculate water measurements using the following procedure.

- Determine the annual rainfall in your area.
- Divide that number by 12 to determine acre-feet.

Note: This will give you the number of feet of rain (acre feet) that fall in your area annually.

- Multiply the acre feet by 326,000 gallons to determine the gallons per acre.

Note: This is the number of gallon in one acre foot.

Assignment Sheet 5

Directions

1. Determine the gallons per acre based on 18" of annual rainfall.

a. Acre feet: _____

b. Gallons per acre: _____

2. Determine the gallons per acre based on 52" of annual rainfall.

a. Acre feet: _____

b. Gallons per acre: _____

- B. News reports carry nearly daily examples of research findings citing alleged health hazards from pollution of water, air, and soil. Usually these reports will cite pollution levels found in increments of parts per million, billion, or trillion.

Using the water measurement figures from the Information Sheets and additional figures given in this assignment, complete the following problems.

1. A flat-bottom municipal swimming pool measures 100 feet by 50 feet and is filled to a depth of four feet. How many gallons does this pool contain?

(Hint) Multiply the length times the width, then multiply that figure times the depth to arrive at the number of cubic feet occupied by the water. Then multiply that number times 7.48 (the number of gallons of water in a cubic foot) to arrive at the answer.

2. The Arkansas River in central Colorado is a prime white water rafting area for thousands of rafters a year. Its flow varies from about 2,000 cubic feet per second during the spring when nearby mountain snows are melting, to about 700 cubic feet per second in the heat of August. If you planned to make a raft trip on the Arkansas and one of the rafting outfitters told you the river's flow was 800 cubic feet per second, how many gallons of water would be flowing across any given point of the river in a second?

a. _____

Now, imagine that amount of water stored in 55 gallon drums. How many 55 gallon drums would that amount of water involve? (Round up to the nearest drum).

b. _____

Assignment Sheet 5

If the average American uses 90 gallons of water per day in household use, how many Americans would a minute's flow of the Arkansas River supply if it were running at 800 cubic feet per second? (Round down to the nearest whole number).

c. _____

3. A water quality test shows traces of the herbicide atrazine in your drinking water supply at the level of 1 part per billion. Based on information supplied in Student Supplement 3, would you have reason to be worried over this level of contamination?

Why or why not? _____

4. A television station in your state has surveyed water quality results from a number of towns and has broadcast a story questioning the safety of several water supplies. Your hometown water supply was found to contain the common home garden and agricultural pesticide carbaryl (Sevin) at a level of 200 parts per billion. Given the information on Pesticide Lifetime Health Advisories in Supplement 3, you have reason to worry about your health?

Why or why not? _____

5. Imagine a flat bottom swimming pool as long as a football field (300 feet) and 115 feet wide, filled to a depth of four feet. For ease of computing, let's say that pool contains exactly 1,000,000 gallons of water, although the actual figure is 1,032,240 gallons. One million gallons of water is equivalent to 128 million ounces. Which of the following would most closely amount to one part per million if it were spilled in this giant pool? (Check one)

_____ a. An eight-ounce carton of chocolate milk

_____ b. A one-ounce bottle of perfume roughly the size of a tube of lipstick

Assignment Sheet 5

6. If the example in problem 5 is representative of a part per million, how much smaller would it be to represent a part per billion?

a. _____

How much smaller would the example in problem 5 have to be to represent a part per trillion?

b. _____

In your opinion, do you think the average television viewer has a realistic idea of the difference between parts per million and parts per trillion?

c. Why or why not? _____

Objective 21

Assignment Sheet 6—Analyze Current Reports Concerning Water Resource Management

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed.	_____
• Minimum of five current articles were read.	_____
• Content is relevant and well organized.	_____
• Report is neat and legible.	_____

Basic Skills



Introduction

As part of your ongoing study of current events as they relate to this unit of instruction, this assignment will allow you to explore the various factions and viewpoints involved in water resource management.

Directions

From publications, newspapers, available web sites, and other resources read a minimum of five current (within the past two years) articles dealing with areas of conflict in water resource management (urban/agriculture; agriculture /recreation; drought; etc.)

Write a report in which you analyze the content of the articles, emphasizing the need to use and protect water resources for the benefit of the varied interests involved.

Note: Be sure to include information about the articles in your bibliography.

Objective 38

Assignment Sheet 1—Determine Land Capability Classes

Name _____ Overall Rating _____

Date _____

Evaluation Criteria

Rating

- Directions have been followed _____
- Soil factors were identified _____
- Land capability classes were determined _____

Basic Skills



Reading



Science



Critical Thinking

Introduction

Land is classified by the USDA on the basis of permanent limitations or hazards in its use from the standpoint of keeping soil permanently productive. The major soil factors of a particular area are all considered when determining the land capability class.

Directions

Using the information provided for each of the following fields, determine the land capability class for each field.

- Write the appropriate category for each soil factor in the blanks provided. Examples: Texture Medium; Depth Deep; and so forth.
- Determine the land capability class and write in the blank provided

Note: Refer to Objectives 12 through 23 for additional information or clarification.

Field #1: Characteristics include :

- Texture: soil feels gritty but contains enough silt and clay to make moist soil hold together
- Depth: over 40 inches
- Slope: 2 feet elevation change
- Erosion: shows no obvious effect of erosion
- Permeability: subsoil is friable to very friable with large pores
- Surface runoff: water drains away readily but yet slow enough that a large amount of water enters the soil

Texture _____

Erosion _____

Depth _____

Permeability _____

Slope _____

Surface Runoff _____

Land Capability Class _____

Assignment Sheet 1

Field #2: Characteristics include:

- Texture: soil is loose, very friable and the individual grains can be readily seen or felt
- Depth: 30 inches
- Slope: 9 feet elevation change
- Erosion: original top soil was 16 inches; current top soil is 4 inches; has a large uncrossable gully
- Permeability: subsoil tends to be very friable or loose when moist
- Surface runoff: water is removed from soil surface at a rapid rate

Texture _____ Erosion _____

Depth _____ Permeability _____

Slope _____ Surface Runoff _____

Land Capability Class _____

Field #3: Characteristics include:

- Texture: soil breaks into clods or lumps when dry; it will form a short well-formed ribbon with a shiny surface
- Depth: over 40 inches
- Slope: less than 1 foot elevation change
- Erosion: less than 25% of top soil has been removed; no gullies are present
- Permeability: subsoil is firm when moist and firm when dry
- Surface runoff: water flows away so slowly that free water covers the soil for moderate periods
- Other: field is in a frequent flood plain

Texture _____ Erosion _____

Depth _____ Permeability _____

Slope _____ Surface Runoff _____

Land Capability Class _____

Assignment Sheet 1

Field #4: Characteristics include:

- Texture: Soil has a slightly smooth or velvety feel when moist
- Depth: 35 inches
- Slope: 4 feet elevation change
- Erosion: 40% of original top soil present; two crossable gullies are present
- Permeability: subsoil is friable to very friable with large pores; roots are present
- Surface runoff: water is removed from the soil surface at a rapid rate

Texture _____

Erosion _____

Depth _____

Permeability _____

Slope _____

Surface Runoff _____

Land Capability Class _____

Objective 39

Assignment Sheet 2—Determine Fertilizer Composition and Rates

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers are correct	_____
• Assignment was completed on time	_____

Basic Skills



Reading



Mathematics



Science



Critical Thinking

Introduction

Commercial fertilizers come in a variety of strengths and blends. This exercise will test your ability to determine the percentages of plant nutrients in a number of different fertilizer blends.

Directions

After reviewing Student Supplement 1, answer the following questions concerning fertilizer composition and rates.

1. Identify and record the proper percentages of plant nutrients in the following fertilizer blends.

- a. 18-46-0 _____
- b. 33-0-0 _____
- c. 35-10-11 _____
- d. 0-0-24 _____
- e. 10-20-10 _____

Assignment Sheet 2

2. Determine the number of pounds of the given plant nutrient in 2000 lbs. of the following fertilizer blends.
 - a. 15-30-15 (Phosphorus) _____ lbs.
 - b. 82-0-0 (Nitrogen) _____ lbs.
 - c. 17-17-17 (Sulfur) _____ lbs.
 - d. 5-10-5 (Potassium) _____ lbs.
 - e. 18-46-0 (Potassium) _____ lbs.
3. Read the following scenarios and answer accordingly.
 - a. A soil test shows you need only nitrogen at the rate of 100 lbs. per acre to maintain the grass on a one-half acre park you are maintaining. If the only fertilizer you have is a 5-10-5 blend, how many lbs. of fertilizer will you need to apply to the park to achieve the 100 lbs. per acre rate of nitrogen?

 - b. If you could use ammonium nitrate (33-0-0), how many lbs. of fertilizer will you have to use to apply 100 lbs. per acre to the park?

 - c. If ammonium nitrate cost \$200 per ton (2,000 lbs.), how much would your fertilizer application cost?

 - d. If you used the 5-10-5 blend and it cost \$7 per 50 lb. sack, how much would your fertilizer application cost?

 - e. How much could you save by using ammonium nitrate instead of the 5-10-5 blend?

4. If you were paying for the fertilizer application in question 3, which fertilizer would you use? Why?

Assignment Sheet 2

5. A midwest corn grower wants to plant a 100 acre field. A soil sample analysis from a reputable soil testing laboratory indicates she needs 100 lbs. of actual nitrogen per acre and no additional phosphorus or potassium for optimum corn production. Based on the following fertilizers available to her, which would represent the most cost-effective choice if application costs are all equal? (Circle your response)

- a. 18-46-0 at \$150 per ton
- b. 33-0-0 at \$200 per ton
- c. 82-0-0 at \$250 per ton

6. Why do you think farmers would be unwise to fertilize by guessing at application rates versus spending \$6 to \$12 on a calibrated soil test to determine recommended rates?

7. As spring gets underway and lawns begin to green up, a homeowner sees an advertisement from a lawn and garden store featuring 40 lb. sacks of 5-10-5 lawn fertilizer for \$4.00 each. The local feed dealer is not having a sale, but sells 10-20-10 fertilizer everyday for \$6 per 50 lb. sack. Assuming the homeowner's lawn needs a total of 20 lbs. of actual nitrogen and can use the P and K in each of the blends, which is the best buy? Why?

8. If a Missouri rancher has access to chicken litter (manure and bedding) which contains 5 percent nitrogen and he applies this litter to pastures at the rate of 2 tons per acre, how much actual nitrogen per acre would he have placed on his pastures?

9. A soil sample shows your front lawn needs nitrogen at the rate of 50 lbs. per acre to sustain bermudagrass growth through the summer. Assuming your lawn is one-tenth of an acre, how much 10-20-10 fertilizer would it take to provide the recommended amount of nitrogen?

Objective 40

Assignment Sheet 3—Read a Soil Test Report

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers are correct	_____
• Assignment was completed on time	_____

Basic Skills



Directions

Using the soil test report on the following page or one provided by your instructor, answer the questions below.

1. What is the field designation number? _____
2. What is the laboratory number? _____
3. Soil test results: _____
 - a. Pounds of nitrogen— _____
 - b. Percent of organic matter— _____
 - c. Pounds of phosphorus— _____
 - d. Pounds of potassium— _____
 - e. pH— _____
 - f. Texture— _____
4. Interpretation of test results:
 - a. What is the level of nitrogen? _____
 - b. What is the level of phosphorus? _____
 - c. What is the level of potassium? _____
 - d. What is the level of organic matter? _____

Assignment Sheet 3

SOIL TEST REPORT

SOUTH DAKOTA STATE UNIVERSITY • SOIL TESTING LAB • 07 AG. HALL • BROOKINGS, SD 57007

TO—

HURON FFA-VOC. SCHOOL
18TH & ARIZONA S.W.
HURON

SD 57350

County BEADLE
Laboratory No.: 79164
Date Received: 03-27-03
Date Reported: 03-27-03
Record Number: 1058

INTERPRETATION OF SOIL TEST RESULTS

Alkaline	Satisfactory	H I G H
Satisfactory	Possible Problem	M E D I U M
Acid	Poor	L O W

SOIL TEST RESULTS

Field Number	Soil Texture	Soil pH	Soluble Salts mmho/cm	Sodium me/1	Organic Matter %	Nitrogen NO ₃ -N Top lb/A	Total lb/A	Phosphorus P lb/A	Potassium K lb/A	Sulfur SO ₄ -S Top lb/A	Total lb/A	Zinc ppm	Iron ppm	Manganese ppm	Copper ppm	Calcium ppm	Magnesium ppm
1	FINE	7.6	0.4		2.4	13	44	8	730								

RECOMMENDATIONS

In 2003 for 50 BU/A OATS					N lb/A	P ₂ O ₅ lb/A	K ₂ O lb/A	S lb/A	Zn lb/A	Fe lb/A	Mn lb/A	Cu lb/A	Ca lb/A	Mg lb/A
1st choice					21	26	0							
2nd choice														

The P205 recommendation can be reduced by one-third if applying as a starter

For additional information contact
your County Extension Agent:

These statements are for the
first crop choice

HURON SD 57350

Objective 41

Assignment Sheet 4—Report on GIS/GPS Technology and Utilization

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Report shows grasp of subject and appropriate research effort	_____
• Sources were included	_____
• Report is neat and legible	_____

Basic Skills



Reading



Writing



Science

Oral
CommunicationCritical
Thinking

Introduction

With affordable satellite mapping and location technology available to individuals, business and industry, and government agencies, there has been a lot of activity building Geographic Information Systems (GIS). GIS, with the aid of the Global Positioning System (GPS), can be used to assist in map development, protect sensitive environmental areas, and irrigate and fertilize farm fields almost on a custom basis according to soil type and slope. GIS/GPS has also spread into construction, recreation, land use planning, farming, and law enforcement. This assignment will allow you to consult your library, the internet, and local businesses and industry to research recent activities in these areas.

Directions

Using information from your research, write a report detailing how GIS/GPS can be used.

Research may include information provided by your instructor; articles from current magazines and periodicals; internet web site searches such as www.aero.org/publications/GPSPPrimer, www.trimble.com, or www.gis.com; interviews and brochures from your local new farm implement dealer or new car dealership; local construction firms; state highway department and others who may use GIS/GPS technology.

The report should include:

- What is it?
- How does it work?
- How can it be used in our everyday life?
- What are the advantages and/or disadvantages?
- Are there possible conflicts from the use of this technology?
Example: privacy issues
- Where can additional information be found?
- What sources were used to write this report?

Be prepared to discuss your research findings.

Note: Check with your instructor for additional instructions.

Objective 42

Assignment Sheet 5—Read a Soil Survey Map

Name _____ Overall Rating _____

Date _____

Evaluation Criteria

Rating

- Directions have been followed _____
- Answers are correct _____
- Assignment was completed on time _____

Basic Skills



Reading



Science



Critical Thinking

Directions

Using the soil survey map on the next page, answer the following questions.

1. List the different soil type map symbols.
 - a. _____
 - b. _____
 - c. _____
 - d. _____
2. In what corner of the map is the large residential area? _____
3. What soil type is found in the residential area? _____
4. What soil type is located in areas of streams and possible lowlands?

5. What soil type is located east of the farmstead? _____

Assignment Sheet 5

Soil Survey Map



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Objective 43

Assignment Sheet 6—Read a Conservation Plan Map

Name _____ Overall Rating _____

Date _____

Evaluation Criteria

Rating

- Directions have been followed _____
- Answers are correct _____
- Assignment was completed on time _____

Basic Skills



Directions

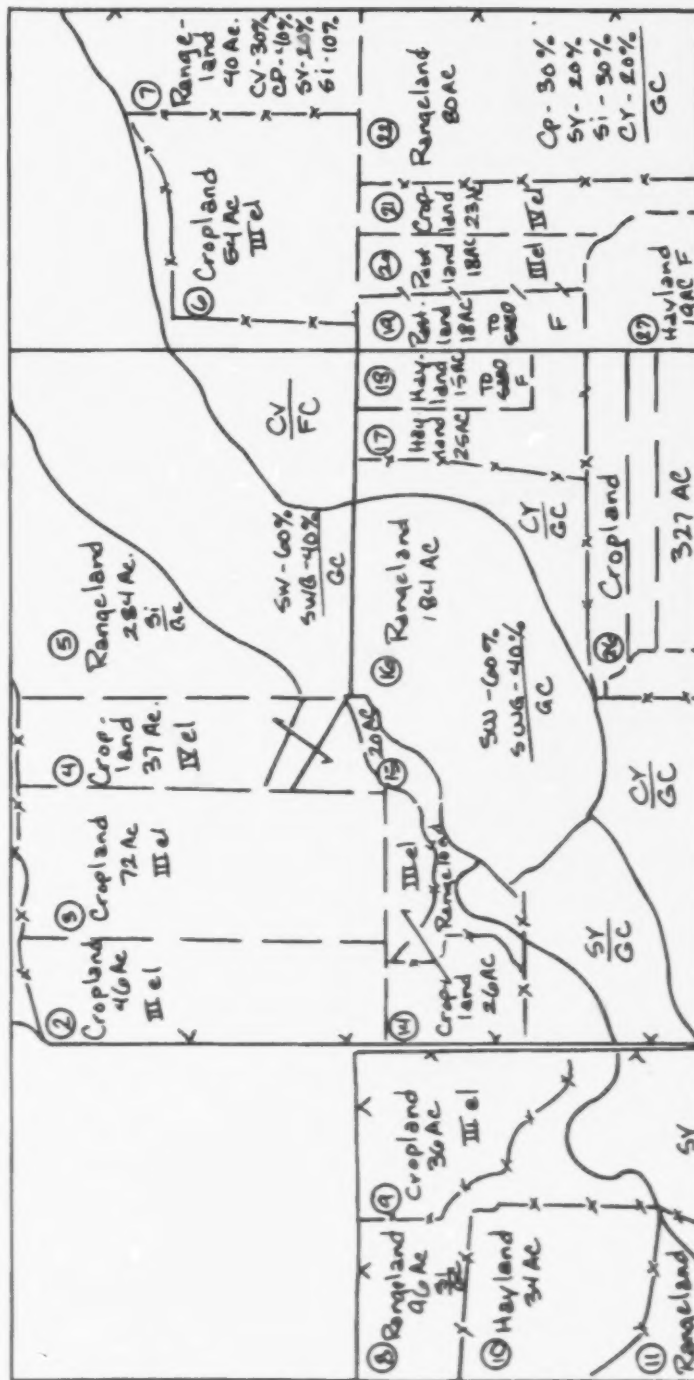
Using the conservation plan map provided on the next page, answer the following questions.

1. What is the county? _____
2. Who was the USDA Natural Resources Conservation Service person who assisted in the development of this plan? _____
3. How many acres are in field number 2? _____
4. What is field number 5 used for? _____
5. What is the land capability class of field number 9? _____
6. What is the conservation practice for field number 19? _____
7. What is the field number 6 used for? _____
8. Who owns this land? _____
9. How many acres are in field number 17? _____
10. What is the land capability class of field number 4? _____

Assignment Sheet 6

Conservation Plan Map (only part of map shown)

Owner Darold Hehn Operator same Date 6/03
 County/Parish Tillman State SD Appx. acres 2320 Appx. scale 1"=1320'
 Cooperating with Tillman Conservation District Assisted by Mary Kellum USDA-NRCS



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Objective 44

Assignment Sheet 7—Complete a Land Use Planning Summary

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Calculations are correct	_____
• Assignment is neat and legible	_____
• Assignment was completed on time	_____

Basic Skills



Reading



Mathematics



Science



Critical Thinking

Directions

Using the information provided, complete the Land Use Planning Summary on the next page or one provided by your instructor.

1. The 37 acres of field number one are in hayland.
2. The 16 acres of field number two are in hayland.
3. The planned practice for field number two is to seed in 2003.
4. The 2 acres of field number three are for the farmstead.
5. The 47 acres of field number four are for wildlife.
6. The planned practice for field number four is brush control in 2004.
7. The 138 acres of field number five are for rangeland.
8. The planned practice for field number five is to cross fence in 2005.
9. The 45 acres of field number six are for pastureland.
10. The planned practice for field number six is to seed in 2003.
11. Calculate the total acres and place in appropriate places at top and bottom of form.

Assignment Sheet 7

USDA-SCS

LAND USE PLANNING SUMMARY

Cooperator _____ Acres _____ CD _____

Assisted by _____ Date _____

		Land Use					Planned Practices
Field	Acres	Hay Land	Wild Life	Farm Stead	Range Land	Pasture Land	
Total							

Objective 45

Job Sheet 1—Take a Lawn and Garden Soil Sample

Name _____ Attempt Number _____

Date _____ Overall Rating _____

Evaluation Criteria

Rating

- Demonstrated proper use of equipment
- Properly chose sampling spots
- Properly mixed samples
- Correctly filled out soil sample sheet

Basic Skills



Reading



Mathematics



Science



Critical Thinking

Instructions

When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the evaluation criteria.

Tools, Equipment, and Materials

- Soil tube, soil auger, garden trowel, or spade
- Plastic bucket
- Soil sampling information sheet provided by instructor

Procedure

- ☐ 1. Scrape away any surface mat of grass or litter.
- ☐ 2. Sample the lawn and garden areas to the depth indicated below.
 - a. Existing grass = 0-3 inches
 - b. For new grass = 0-6 inches
 - c. Gardens = 0-6 inches
 - d. Trees and shrubs = 0-12 inches

Note: Avoid taking samples in areas like borders, low spots, near trees, or near building.
- ☐ 3. Place the soil in a clean bucket or pan.
- ☐ 4. Sample in at least 10 spots within the area.
- ☐ 5. Mix samples of soil well to make a composite sample.
- ☐ 6. If samples are wet, air dry before placing in soil sample container.
- ☐ 7. Fill out the soil sample information sheet provided by your instructor. An example is provided.

Job Sheet 1

- ☐ 8. Enclose the information sheet and the soil sample in a sturdy carton.
- ☐ 9. Send the package to the soil testing laboratory.

Evaluator's Comments: _____

Das Wort Dartsch

Unit 5

Air Resource Management

Objective 16

Assignment Sheet 1—Locate Sources of Air Pollution In Your Area

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Survey is thorough	_____
• Answers indicate cognitive grasp of unit information and critical thinking	_____
• Report is neat and legible	_____
• Report was completed on time	_____
• Worked cooperatively with others to reach a common goal	_____

Basic Skills



Reading



Writing



Science



Oral Communication



Critical Thinking



Interpersonal

Introduction

Air pollutants can create serious health hazards such as respiratory illness, lung damage, and brain damage. Air pollution can also cause serious environmental problems. Acid rain and smog are two common results of air pollution.

In this assignment you will survey your local area for sources of outdoor pollution, and you will have an opportunity to learn about pollution control devices that are being used to combat air pollution.

Directions

Work in a team, as assigned by your instructor, to survey sources of outdoor air pollution in your area, then complete the following chart. Note the source, location, whether the pollution is obvious, and if any pollution control devices are being used. Select a team member to present your findings to the rest of the class. Every team member should be prepared to participate in the class discussion.

Pollution Source	Location	Is pollution obvious?	Pollution Control Device/Description

Unit 5

Air Resource Management

Objective 17

Assignment Sheet 2—Write a Report on an Environmental Problem Related to Air Quality

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Report is informative	_____
• Problem is well-defined	_____
• Solutions indicate cognitive grasp of subject	_____
• Future outlook is logical	_____
• Report is neat and legible and free of typos	_____
• Assignment was completed on time	_____

Basic Skills



Reading



Writing



Science



Critical Thinking



Technology

Introduction

Although the United States is bordered on the east and west by the Atlantic and Pacific oceans and although many countries are hundreds of miles from the North American continent, air pollutants generated in other parts of the world can have a significant impact on air quality in the U.S. Therefore, international organizations such as the United Nations and the World Health Organization must seek the cooperation of the international community in global air resource management. If tomorrow's air is to be cleaner, today's activities must include consideration of air quality.

In this assignment you will study an environmental problem related to air quality and report on what is being done to solve the problem. The environmental problem may be a local, state, national, and/or global problem.

Directions

1. Select an environmental problem for your report.

Examples: Greenhouse effect, ozone shield, acid rain, smog, inside air pollution, ambient air pollution, auto emissions

2. Research your chosen environmental problem, using the Internet or the school or community library.

Assignment Sheet 2

3. Write your report.

Note: The report should be double-spaced, two to three pages in length (not counting the title page) and include the following:

- Title page—subject title, your name, class period, date
- Body of paper to include
 - Problem
 - Causes of problem
 - Solutions to the problem
 - Future outlook
- Bibliography—Sources of information for report

4. Prepare your report using a computer if available.

5. Submit your report by due date.

Unit 5

Air Resource Management

Objective 18

Assignment Sheet 3—Maintain a Weather Log for 10 Days

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Log is neat and orderly	_____
• Log is accurate and well documented	_____
• Report reflects cognitive grasp of subject	_____
• Report is neat and legible	_____
• Report was completed on time	_____

Basic Skills



Reading



Writing



Science



Critical
Thinking



Technology

Introduction

Looking out the window to see it raining, or to see a bright sunny day, can tell you what the weather is like at the moment you observe it. To get a better idea of what weather trends are like, it's necessary to track weather conditions over a longer period of time. This exercise will give you a 10-day period in which to observe the weather conditions in your area and to compare those observations with professional weather forecast results.

Directions

- Using the weather log included in this assignment, keep a daily record of weather conditions at your school or home for 10 consecutive days. Attempt to observe the weather at the same time each day, take readings and take notes.
- Watch television or listen to radio weather segments each day, or access weather reports on an on-line computer service or a daily newspaper. Take notes on forecasts and current conditions reported by professional meteorologists.
- Compare your observations with those of the professional meteorologists in a report to be submitted to your instructor.

Note: Your report should be no more than two pages and should detail how your observations coincided with the professional weather forecasts.

Assignment Sheet 3

Weather Log									
Daily Weather Record									
	Date	Time	Barometric Pressure	Temperature	Relative Humidity	Precipitation (rain/snow)	Wind Direction	Wind Speed	Cloud Conditions
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

Objective 19

Assignment Sheet 4—Formulate Weather Forecasts

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Student recorded daily weather data accurately	_____
• Student used weather forecast chart accurately when cross-referencing barometric readings and trends with existing wind conditions	_____
• Student presented weather forecast, based on observations, in a clear and concise manner	_____

Basic Skills



Reading



Science

Oral
CommunicationCritical
Thinking

Technology

Introduction

Forecasting the weather is an inexact science with many variables to cause imprecise predictions. Still the ability to predict general trends and the general possibility of storms or fair weather is interesting as well as important. This assignment sheet will lead you through the scientific observations needed to formulate a weather broadcast that promises to be relatively accurate over a 24 or 48 hour period.

Directions

1. Use a copy of the "Weather Log" you completed for Assignment 3.

Note: Review the barometer readings and trends, wind direction, and cloud conditions you observed.

2. Read Student Supplement 3 — Forecasting the Weather.
3. Formulate a weather forecast for the next 24 to 48 hours.
 - Review the "Barometric Pressure and Wind Forecast Chart" in Student Supplement 3 to further refine your forecast.
4. Present your forecast to the class and discuss your observations and the reasoning behind our forecast.
 - Don't change your forecast to match others if there are discrepancies. You are dealing with relatively reliable forecasting tools.

Assignment Sheet 4

5. Compare your forecast with professional meteorologists' outlook.
 - Watch local television weather broadcasts or listen to radio forecasts.
 - If possible, monitor weather maps available from an on-line computer service or daily newspaper.
6. Did your forecast match that of the professionals? Why?

Objective 18

Assignment Sheet 1—Discuss the Effects of Our Dependence on Imported Oil

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Effects are feasible and well thought out	_____
• Lists are thorough	_____
• Participated in class discussion	_____
• Assignment is neat and legible	_____
• Assignment was completed on time	_____

Basic Skills



Reading



Writing

Oral
Communication

Mathematics

Introduction

The United States imports approximately 50% of our oil needs. We are dependent on other countries in the world for their oil to meet our remaining needs. There are coalitions of countries that work together to control their supplies of oil. In the past, nations have refused to sell oil (called an embargo) to the U.S. because of political beliefs. Several oil-producing countries have had internal political unrest and/or military conflicts. Each time the effects rippled through the U.S. economy — affecting prices, interest rates, industrial output, etc. This exercise will lead you through possible effects our dependence on imported oil has on you personally.

Directions

1. Use two separate sheets of paper.
2. On one sheet list the effects our dependence on imported oil has on the citizens of the United States and on our national economy.
3. On the other sheet list the effects on you personally.
4. Discuss your lists in class.

Objective 19

Assignment Sheet 2—Compare Electricity Production From Coal and Nuclear Fuels

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Comparisons are logical	_____
• Comparisons are thorough	_____
• Assignment is neat and legible	_____
• Assignment was completed on time	_____

Basic Skills

Reading



Writing



Mathematics



Science

Oral
Communication**Introduction**

The U.S. has had nuclear power plants operating since the mid 1950s with few emergencies or problems. Still the disaster at Three Mile Island in 1978 and the problems with nuclear waste disposal have set the nation at odds over the use of the atom to develop electricity. Coal-fired power plants, too, have their problems, but both nuclear and coal-fueled plants offer several centuries of production potential. This exercise will allow you to explore your ideas about each.

Directions

Compare the positive and negative aspects of electricity production from coal and nuclear fuels. Cover the following points:

- Renewable or nonrenewable resource
- Economics
- Safety
- Environmental problems
- Future use

What are your personal concerns about using coal and nuclear fuel?

Objective 20

Assignment Sheet 3—Give Your Opinion on Using Agriculture Products as Alternative Energy Resources

Name _____ Overall Rating _____

Date _____

Evaluation Criteria**Rating**

- Report is thorough _____
- Report is informative _____
- Report is neat and legible _____
- Assignment was completed on time _____

Basic Skills

Reading



Writing



Mathematics



Science

Oral
Communication**Introduction**

With conventional sources of energy limited, many people feel the products formed from plants hold the key to future energy sources. Biomass conversion does yield useful products, but there are economic and political considerations to be dealt with. This exercise will familiarize you with several aspects of the problem.

Directions

1. Research the biomass conversion process.
2. Compile a written report with the following points;
 - List the agricultural products which can be used.
 - Identify and describe how these products are used as alternative energy sources.
 - Give your opinion of the future of agricultural products as alternative energy sources.
 - List of sources (bibliography)

Objective 21

Assignment Sheet 4—Perform an Energy Audit of Your Home

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Audit is completed as required	_____
• Recommendations are appropriate	_____
• Assignment is neat and legible	_____
• Assignment was completed on time	_____

Basic Skills



Reading



Writing



Mathematics



Science

Oral
Communication

Introduction

Every home has some areas where energy use could be reduced without undo hardship on those who live there. This exercise will lead you to areas where you can save energy and money in your own home.

Directions

Complete the following inspection of your home and then make recommendations for improvement. Take notes on your inspection form.

1. Inspect doors to the outside.

- Does house have storm doors? _____
- Do doors have weatherstripping? _____
- Are doors properly caulked? _____
- How many layers of glass are there in the doors?
 - ☐ single pane
 - ☐ double pane
 - ☐ triple pane

2. Inspect windows

- Do windows close tightly? _____
- Are window frames properly caulked? _____

Assignment Sheet 4

- Are there any broken windows? _____
- How many layers of glass are there in the windows?
 - ☐ single pane
 - ☐ double pane
 - ☐ triple pane
- Are storm windows used during cold winter months? _____
- What kind of frames do the windows have? (wood, metal, some of each) _____
- How are windows covered inside to control light and prevent heat loss and gain? _____
 - Blinds _____ Drapes _____
 - Shutters _____ Reflective coating _____
 - Shades _____ Other _____
 - Curtains _____ None _____
- How many windows are located on each outside wall?
 - North _____ South _____
 - East _____ West _____

3. Inspect home exterior.

- Is recaulking needed? _____
- Are other repairs needed to prevent heat loss? _____
- Are plumbing entries tightly sealed? _____
- Are crawl-space entries sealed? _____
- Are mail-slots closing tightly? _____
- Are dryer outlets sealed? _____
- Are air-conditioning outlets sealed? _____
- Are other exhaust outlets sealed? _____

Assignment Sheet 4

4. Check for air leaks.

- Shut off forced-air furnace (if used in your home), and use a draft indicator to check doors. Are there air leaks? _____
- Are there leaks around windows? _____
- Are there leaks around corners of exterior walls? _____
- Are there leaks around floor and floor boards? _____
- Are there leaks around plumbing entries under sinks along exterior walls? _____
- Are there leaks around electrical outlets and exterior walls? _____
- Turn heat back on if you turned it off in Step 4a. _____

5. Inspect insulation and find out what kind of insulation the home has.

- Is there blown-in or blanket insulation in the attic or ceiling area? _____ What thickness? _____ What R-value? _____
- Is there insulation in the walls? _____
- Is there insulation in the floors/foundation? _____
- Complete the following chart if the information is available.

Area	Recommended R-value	Insulation		R-value of Insulation
		Yes	No	
Ceiling/Roof				
Walls				
Floors/Foundation				

6. Inspect lighting.

- Are lights left on in rooms or areas when not in use? _____
- Are fluorescent bulbs used in lights and fixtures whenever possible? _____
- Are walls a light color for good reflection? _____
- What kind of natural lighting is used? (windows, skylights) _____

Assignment Sheet 4

7. Inspect fireplace if the home has one.

- Is the vent closed when not in use? _____
- Does fireplace have glass doors to prevent heat loss? _____
- Does fireplace have a method of circulating air and heat? _____

8. Inspect hot water heater.

- Check water temperature with thermometer. _____
- Record temperature. _____
- Are hot water pipes and water heater insulated? _____
- Are any hot water faucets leaking? _____
- Are the clothes washer and dishwasher used only with full loads? _____
- Are flow restrictors used on shower heads and sink faucets? _____

9. Check heating, ventilation, and air conditioning.

- Complete the following table (change names to fit rooms in the home.)

Room	Actual Temp.	Heat or Air Cond. Register		Thermostat in Room		Thermostat Setting
		Open	Closed	Yes	No	
Living						
Dining						
Kitchen						
Bathroom 1						
Bathroom 2						
Bedroom 1						
Bedroom 2						
Bedroom 3						
Hall						

- Is the thermostat lowered at night? _____
- Is the thermostat set at 65°F or lower in the heating season and 78°F or higher in the cooling season? _____

Assignment Sheet 4

- Is the heating system forced air or a convection system?

- Are heating and cooling vents clean and unblocked? _____
- Are there filters on air conditioners and furnaces? _____
- Are filters clean and unclogged? _____
- Are air ducts insulated? _____
- Are hot water pipes insulated? _____
- Are kitchen and bathroom exhaust fans turned off when not needed?

10. Make recommendations for improvements by filling in the chart below.

Low Cost Recommendations

High Cost Recommendations

Objective 22

Assignment Sheet 5—Explore the Various Factions and Viewpoints Involved With the Use of Renewable and Nonrenewable Resources

Name _____ Overall Rating _____

Date _____

Evaluation Criteria**Rating**

- Directions have been followed
- Minimum of five current articles collected
- Content is relevant and well organized
- Report is neat and legible

Basic Skills

Reading



Writing



Mathematics



Science

Oral
Communication**Introduction**

As part of your ongoing study of current events as they relate to this unit of instruction, this assignment will allow you to explore the various factions and viewpoints involved with the use of renewable and nonrenewable resources.

Directions

Using books and magazines from your local or school library, and articles found in on-line computer services, research articles dealing with energy resources, their use, their relative abundance, and political and economic controversies surrounding their use and exploitation.

In all cases there will be emotional stands taken on many sides. Using the information you have collected, consider the sides of the controversy and, write a report based on your research and personal experience concerning your chosen subject.

Suggestions for reports might include:

- The true cost of foreign oil to U.S. economy, considering the military expenditures necessary to maintain open sea lanes from the Persian Gulf to U.S. refineries, and the overall balance of trade deficit resulting from importing 50 percent of U.S. petroleum needs.
- Federally subsidized western water projects for inexpensive hydro-electric power used by desert communities such as Las Vegas.
- The use of corn-based ethanol as a motor fuel.
- The use of soybeans to provide biodiesel.

Assignment Sheet 5

- The controversy over the use of ethanol or MTBE (a petroleum product) in reformulated gasolines.
- If the U.S. has limited petroleum resources, why then was Alaskan sold or provided to other countries?
- In 1973 the U.S. oil reserves were estimated to be depleted in 16 years? Why has the United States not run out of domestic oil?
- With about 20 percent of U.S. electrical needs being met by nuclear-powered generation stations, why have only a few nuclear-powered plants been built since the 1970s?
- Given the dangers of radioactive waste generated by current-technology nuclear fission plants, what is being done to dispose of these growing supplies of spent fuel rods?
- What is the current status of so-called "breeder reactors," which create more nuclear fuel than they use?
- How should environmentalists' concerns about displacing top soil and forest land to strip mine coal for power generation be met, given the nation's need for reliable energy sources?
- Another topic may be selected, if appropriate and approved by the instructor.

Note: For help in finding recent periodicals concerning controversies surrounding the use of energy resources, consult the *Reader's Guide* in your school or community library.

Objective 25

Assignment Sheet 1—Identify Local Trees

Name _____ Overall Rating _____

Date _____

Evaluation Criteria

Rating

- Directions have been followed
- Ten samples are correctly mounted
- Trees are correctly named
- Trees are classified correctly
- Samples are correctly labeled
- Assignment is neat and legible
- Assignment was completed on time

Basic Skills



Reading



Science



Critical Thinking

Introduction

For many people, "trees are trees are trees." Trees line our streets and highways reducing noise, pollution, and effects of wind, but many times are taken for granted. This exercise will acquaint you with 10 tree species in your local area.

Directions

1. Collect leaf samples of ten (10) common trees in your area.
2. Mount these.
3. Identify your trees according to resources provided by your instructor or library.
4. Classify your trees according to resources provided by your instructor or library.

Note: Classify your trees as to whether they are a conifer or deciduous and whether they are softwood or hardwood.

5. Label the respective leaves with the common tree name and classifications.

Objective 26

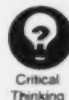
Assignment Sheet 2—Determine the Age of a Tree

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Assignment is completed on time	_____
• Age is correct	_____

Basic Skills



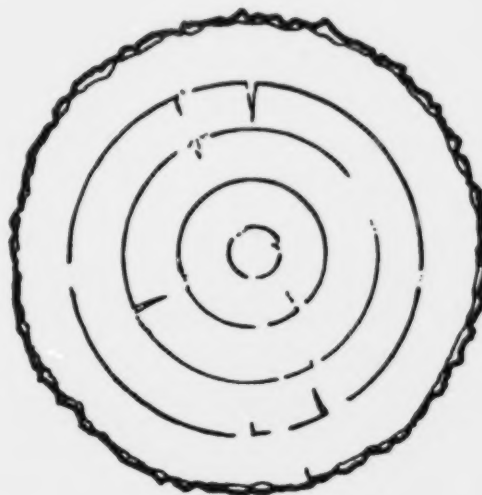
Introduction

Because of natural growth patterns, trees grow incrementally each year, adding layer after layer of wood to their trunk diameter. These layers, or annular rings, are a record of the tree's life. This exercise will acquaint you with calculating a tree's age, and give you insight to the growing conditions present in each of its years of life.

Directions

Given the following cross section of a tree or one provided by your instructor, determine the age by counting the rings. Rings should be counted from the center out.

Age _____



Objective 27

Assignment Sheet 3—Determine Uses of Wood and Wood By-Products

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Ten products and uses are listed	_____
• Assignment is neat and legible	_____
• Assignment was completed on time	_____

Basic Skills



Reading



Science



Critical Thinking

Introduction

Wood plays a large part in our lives, from the houses and buildings we use to the newspapers we read and a host of other products such as plastics and chemicals. It is almost impossible to spend a day in this country without touching, reading, sitting on, eating, wearing, and looking through a wood product. In this exercise you will explore the vast variety of wood products that are used in your area.

Examples:

- Lumber
 - Shop and factory grade (furniture, barrels, boxes, cabinets, flooring, millwork, etc.)
 - Structural grade (joists, planks, laminated wood, etc.)
 - Yard wood grade (boards, dimension, finish, etc.)
- Poles, posts and piles
- Firewood
- Ties for railroad construction
- Converted wood products (paper pulp, wood fiber, charcoal, explosives, and plastics)
- Other wood products (rayon, cellulose, photographic film, sausage cases, sponges, simulated leather, artificial hair, alcohol, shatterproof glass, imitation vanilla, etc.)

Directions

Make a list of ten woods and wood by-products found in your area and their uses.

Assignment Sheet 3

Woods or Wood By-Products	Uses
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

Objective 28

Assignment Sheet 4—Solve Cord Measurement Problems

Name _____ Overall Rating _____

Date _____

Evaluation Criteria

Rating

- Answers are correct _____
- Assignment was completed on time _____

Basic Skills



Reading



Mathematics

Introduction

This exercise is aimed at developing math skills using volumetric measures of wood—the cord.

Directions

Using the formulas provided, solve the following cord measurement problems by placing the answers in the spaces provided. Show your work.

a. $2 \times 4 \times 6 =$

f. $4 \times 6 \times 8 =$

b. $2 \times 4 \times 8 =$

g. $2 \times 8 \times 8 =$

c. $4 \times 4 \times 6 =$

h. $4 \times 4 \times 20 =$

d. $4 \times 4 \times 4 =$

i. $2 \times 6 \times 10 =$

e. $2 \times 2 \times 20 =$

j. $8 \times 8 \times 10 =$

1. Length x width x height = _____ cubic feet

a. _____

f. _____

b. _____

g. _____

c. _____

h. _____

d. _____

i. _____

e. _____

j. _____

Assignment Sheet 4

2. Cubic feet/128 = _____ % of a cord

a. _____ f. _____

b. _____ g. _____

c. _____ h. _____

d. _____ i. _____

e. _____ j. _____

3. Percent of a cord x cost of cord = _____ cost of a pile of wood

Note: Assume the cost of a cord for this problem if \$70.00. Round answers to nearest cents.

a. _____ f. _____

b. _____ g. _____

c. _____ h. _____

d. _____ i. _____

e. _____ j. _____

Objective 29

Assignment Sheet 5—Analyze Areas of Conflict in Maintaining Forests and Urban Trees

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Responses are logical	_____
• Assignment is neat and legible	_____
• Assignment was completed on time	_____

Basic Skills



Reading



Writing



Science



Critical Thinking

Introduction

Forests, forest management practices, and the presence of trees affect everyone. In this exercise you will be asked to explain your reactions to various instances in which decisions about timbered land affect others.

Directions

Read the following scenarios, consider the various "sides" involved and why they do or think what they do, and in your own words respond with your reaction to the situation and what should be done to alleviate the conflict generated in each.

1. Since the time you were small, you and your family have enjoyed primitive camping on a high bluff overlooking a meandering mountain stream in a national forest managed by the U.S. Forest Service. Your photo albums are filled with pictures of activities at this camp site; you claimed a favorite pine tree nearby and charted your growth each year by secretly cutting a notch in its scaly bark each summer; the sound of the wind howling up the creek's canyon through the pine needles eases you to sleep at night even when you're miles away—remembering. It has been a place you have lived, laughed, and grown. Now, your favorite campsite is posted with "No Trespassing" signs and it is only a blackened landscape. It has been charred by fire allowed to burn by the Forest Service under a management plan that refuses to fight fires on FS lands unless they threaten lives or nearby private property. The Forest Service cites studies showing fire is necessary to maintain the vigor of a forest, to regenerate its diversity, and to provide "edge" habitat for wildlife.

What is your reaction? _____

Assignment Sheet 5

2. On a trip to the Rocky Mountains, you and your family drive across miles of Oklahoma, Kansas, and Colorado in June. As you pass through the flat, fertile wheat land of the Southern Plains you watch in wonder as farmers cut thousands of acres of ripened wheat. From fence row to fence row, the giant combines harvest the grain, leaving a dull yellow stubble and a cloud of chaff in their path. As you climb the foothills of the Rockies, you notice many more trees along the road and you see TePee-like metal structures on the outskirts of small towns—TePees with smoke rolling out of their domed tops. You realize these are waste incinerators at small sawmills where hundreds of logs are processed each day into lumber. Further into the mountains, you see a ragged clearing in the timber ahead, and realize a crew of loggers and large tractor-like machines are cutting trees and loading them on large semitrailer trucks. They have cut an area as large as three football fields, and are continuing to cut every tree standing as they move across the forest floor. The scene looks like a giant wind storm has flattened everything in their area.

What is your reaction? How is the clear-cutting logging operation any different than farmers cutting every stalk of wheat on a 600-acre wheat field?

3. You have finally made enough money to purchase your dream home. It sits about 100 feet back from the north-south road, facing west and shaded in the afternoon by gigantic silver maple trees growing along the edge of the property at the road's edge. The huge trees were one of the reasons you "fell in love" with the house. Shade from those trees help you keep your air conditioner bills low by reducing the heat load on the house during summer afternoons. You enjoy the many birds that fly in and out of the trees throughout the year. Then, one Monday morning you realize the local utility company has a crew of workers "topping" your favorite row of silver maples. Using chainsaws and hydraulic lifts they are systematically cutting the upper limbs out of the trees to allow 10 feet of clearance to the electrical power lines that run parallel with the road. The work is leaving giant holes in the trees, ruining their symmetry and promising to allow much of the afternoon sun directly onto your house. You storm out of the house and confront the work crews, only to be told the utility company has an easement on the property and can legally do anything it wants to the trees.

What is your reaction? _____

Assignment Sheet 5

4. You are a rancher whose livelihood depends upon the health of the grass pastures you manage for your cow herd. A scientifically-based practice of annual pasture burning helps you keep native prairie grasses vigorous and free of weeds and interceding stands of grass-shading cedar trees and shinnery shrubs. Also, you have learned the pastures which have been burned in the spring produce better forage for cattle throughout the year—adding profitable pounds to your calves as you sell them in the fall. Your burning management mimics the “wild fires” that once swept across the prairie grasses as a result of lightning strikes, etc.—long before the land was settled and farmed and before fires were automatically termed the enemy. You have watched the weather conditions and found a nearly windless day with cool temperatures and high humidity readings—a perfect day for a controlled burn. You and your workers have planned the burn and are busy lighting fires and precautionary back fires when you see a line of cars and vans (including a TV news crew from a station about-100 miles away in the nearest larger city) pull up to your pasture. Those in the cars get out, jump your fence, and begin fighting the fire with wet sacks and backpack fire extinguishers. Some carry protest signs calling you an air polluter and a pyromaniac. The cameras are rolling and you are very aware someone may be hurt accidentally on your property, fighting the fire you are trying to control.

What is your reaction? _____

5. As a developer of real estate, you have a 40-acre plot of wooded land you wish to subdivide and sell as homesites. As you plan how best to design your subdivision, you realize that by dozing out all of the timber on the plot and selling it for firewood, you could finance much of your land preparation expenses. In addition, without having to plan around stands of trees you could have the land sold and developed much more quickly than if you surveyed the lots in shapes to allow trees to stand. Economically, dozing the trees is the best deal to you.

What is your reaction and what would you do? _____

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Objective 30

Assignment Sheet 6—Analyze Current Reports Concerning Areas of Conflict in Forestry

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Content is relevant and well organized	_____
• Report is neat and legible	_____
• Assignment was completed on time	_____

Basic Skills



Reading



Writing



Science

Oral
CommunicationCritical
Thinking

Technology

Introduction

Throughout this study of natural resources, you will be asked to research and report on a variety of subjects according to material being covered in the specific units of instruction you are studying. In this assignment you will be researching material relevant to forestry.

Directions

1. Use books, magazines, and newspapers from your local or school library, and information found in on-line computer services to research articles dealing with forestry and the controversies surrounding it. For help in finding recent periodicals concerning controversies surrounding forestry, consult the *Reader's Guide* in your school or community library.

Examples of issues to explore would be:

- clear cutting vs. selective cutting;
- various opinions on when and where forest fires should be fought, and if they should be fought;
- monoculture forests vs. varicultures;
- the use of controlled or prescribed burning to maintain a vigorous forest culture; and
- the federal government's role in forest management.

Note: Instructor must approve the topic you have chosen.

2. Write a report.
 - Explain what the controversy is
 - Present all sides of the controversy
 - Describe what actions might be taken to solve the controversy
 - Identify sources of your information (Bibliography)
3. Be prepared to discuss your topic in class.

Objective 31

Job Sheet 1—Plant a Bareroot Tree

Name _____ Attempt Number _____

Date _____ Overall Rating _____

Evaluation Criteria

Rating

- Demonstrated proper use of equipment _____
- Properly prepared hole _____
- Properly placed tree _____
- Practiced safety rules throughout procedure _____

Basic Skills



Reading



Science



Interpersonal



Critical Thinking

Introduction

Following the proper procedure when planting trees can make the difference in the tree's survival. Since the roots provide the necessary nutrients for the tree to grow, how they are positioned in the hole and the proper soil mixture surrounding them is important. In this activity you will learn how to plant a bareroot tree.

Instructions

Before beginning this activity your instructor will divide the class into workteams. Each member should equally contribute to this activity. Your instructor will observe individual and group activities and rate your performance using the evaluation criteria.

Tools, Equipment, and Materials

- Spade Sand shovel
- Yard stick
- Plastic sheeting
- Peat moss or other organic matter
- Bareroot tree
- Safety equipment as needed—gloves, hard hats, eye and ear protection

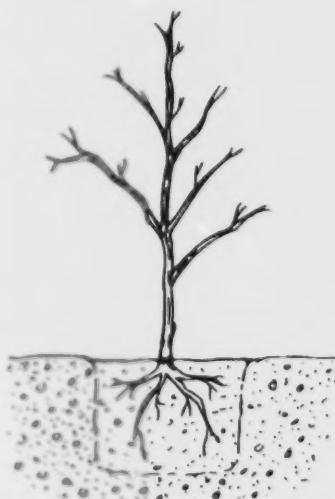
Procedure

- ☐ 1. Assemble the needed equipment and materials, and carry them to the planting site.
- ☐ 2. Make a planting hole with the shovel, twice as wide and slightly deeper than the root mass of the tree.
- ☐ 3. As you remove soil from the hole, place it on plastic sheeting and mix it with organic matter or peat moss.
- ☐ 4. Adjust depth of hole by adding soil mixture so the tree will be the same depth or slightly higher than it was in the nursery.

Job Sheet 1

- ☐ 5. Place the yard stick across the hole to assist in the depth determination.
- ☐ 6. Remove any broken or damaged roots from the root mass.
- ☐ 7. Place the tree in the hole, making sure the roots are in a natural position.
- ☐ 8. Straighten tree, viewing it from all sides.
- ☐ 9. Fill in the hole with the soil mixture.

Figure 1



- ☐ 10. Thoroughly soak the soil to eliminate air pockets.
- ☐ 11. After water drains away, fill in with the rest of the soil mixture and soak again.
- ☐ 12. Return equipment and materials to the storage area and put away properly.

Evaluator's Comments: _____

Objective 32

Job Sheet 2—Measure Diameter of a Tree

Name _____ Attempt Number _____

Date _____ Overall Rating _____

Evaluation Criteria

Rating

- Demonstrated proper use of equipment
- Took accurate measurements
- Make correct readings
- Practiced safety rules throughout procedure

Basic Skills



Reading



Mathematics



Science

Introduction

By measuring the diameter of a tree you can determine how much lumber it will produce when cut. This is a simple method that may be used to select mature trees for cutting.

Instructions

When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the evaluation criteria.

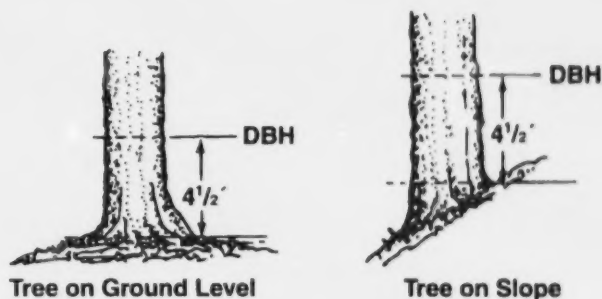
Tools, Equipment, and Materials

- Diameter tape
- Carpenter's tape
- Safety equipment as needed—gloves, hard hats, eye and ear protection

Procedure

- ☐ 1. Assemble the needed equipment and materials, and carry them to the tree site.
- ☐ 2. With the carpenter's tape, measure to a height of 4.5 feet (DBH) above the ground level or on uphill side of tree. (Figure 1)

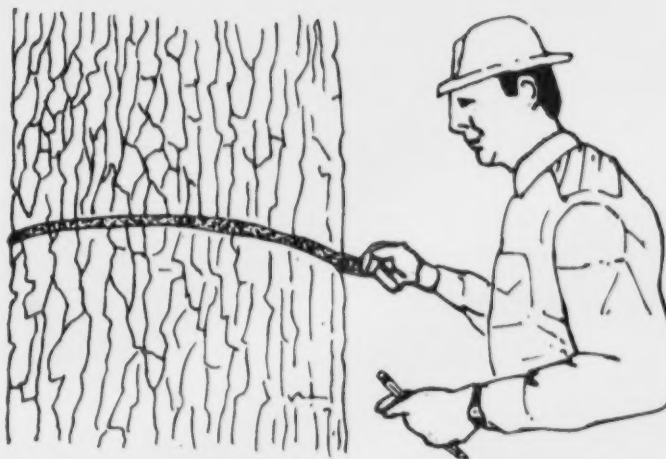
Figure 1



Job Sheet 2

- ☐ 3. Secure the end of the diameter tape to the bark at the 4.5 foot height.
- ☐ 4. Extend the diameter tape around the tree until it meets the end. (Figure 2)

Figure 2



- ☐ 5. Read the diameter directly from the tape to the nearest inch
- ☐ 6. Return equipment and materials to the storage area, and put away properly.

Evaluator's Comments: _____

Objective 33

Job Sheet 3—Measure Merchantable Height of a Tree

Name _____ Attempt Number _____

Date _____ Overall Rating _____

Evaluation Criteria

Rating

- Demonstrated proper use of equipment _____
- Took accurate measurement _____
- Held tree scale properly _____
- Practiced safety rules throughout procedure _____

Basic Skills



Reading



Mathematics



Science

Introduction

Various species of trees have different growing patterns with some gaining height and breadth much faster. Loggers know the importance of selecting mature trees for cutting to ensure profitability. In this activity you will measure the merchantable height of a tree to determine how many logs it will produce.

Instructions

Before beginning this activity your instructor will divide the class into workteams. Each member should equally contribute to this activity. Your instructor will observe individual and group activities and rate your performance using the evaluation criteria.

Tools,
Equipment,
and Materials

- Tree scale stick (Biltmore stick)
- 100 foot tape
- Safety equipment as needed—gloves, hard hats, eye and ear protection

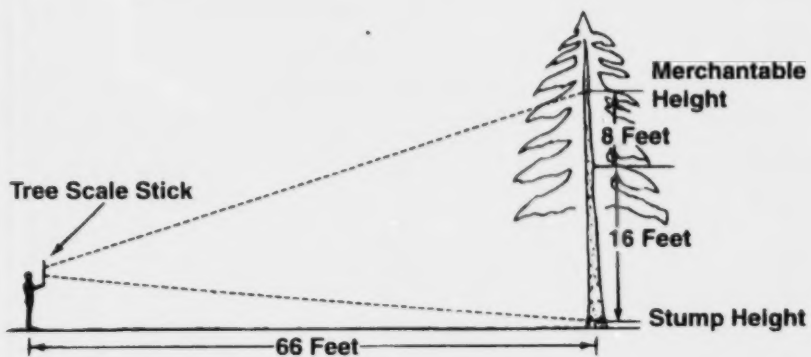
Procedure

- ☐ 1. Assemble the needed equipment and materials, and carry them to the site where tree is to be measured.
- ☐ 2. Measure a distance of 66 feet from the base of the tree.
- ☐ 3. While standing at the 66-foot mark, hold the stick outright, 25 inches from the eye.
- ☐ 4. View the bottom of the stick at the cut-off point for sawtimber trees (stump height) (6-10 inches from the ground).
- ☐ 5. View the merchantable height of the tree (6" diameter inside bark).

Job Sheet 3

- ☐ 6. Using the tree scale, determine how many 16-foot logs and half logs can be cut from the tree.

Figure 1



- ☐ 7. Return equipment and materials to the storage area, and put away properly.

Evaluator's Comments: _____

Objective 25

Assignment Sheet 1—Explain Effects on a Food Chain When Parts Are Removed

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Explanations are logical	_____
• Participated in class discussion	_____
• Assignment is neat and legible	_____
• Assignment was completed on time	_____

Basic Skills**Introduction**

As you learned in Objective 2, a food chain is the connecting link between various organisms as they eat to survive and multiply. Food chains are a necessary part of the ecosystem. Without them, there would be no way to naturally control wildlife populations. In this assignment, you will study how the food chain is disrupted when parts are removed.

Directions

Use the following food chain consisting of five organisms. Record the results as various parts are removed. Be prepared to discuss your findings in class.

Food Chain: Grass → Grasshopper → Frog → Snake → Hawk

1. Begin by removing the hawk from the chain.

Explain the result or change in the ecological system.

2. Replace the hawk in the chain and remove the snake.

Explain the result or change in the ecological system.

Assignment Sheet 1

3. Replace the snake and remove the frog.

Explain the result or change in the ecological system.

4. Replace the frog and remove the grasshopper.

Explain the result or change in the ecological system.

5. Replace the grasshopper and remove the grass.

Explain the result or change in the ecological system.

6. Briefly discuss what you have learned about the effects on a food chain when parts are removed?

Objective 26

Assignment Sheet 2—Create a Food Web

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Ten organisms are used	_____
• Organisms are correctly identified	_____
• Assignment is neat and legible	_____
• Assignment was completed on time	_____

Basic Skills



Introduction

The purpose of a food web is to show the interconnecting food chains in an ecosystem. From a food web, you can see how organisms depend on each other for survival. In this assignment, you will create a food web to learn more about the dependent relationship of organisms as well as their food preferences.

Directions

1. Find pictures of ten organisms that interconnect in a food chain.
2. Cut their pictures from magazines, newspapers, or wildlife brochures.
3. Attach pictures to a white poster board in a circle to form a food web.
4. Draw arrows pointing to the consumer of each organism.
5. Identify each as producers, herbivores, carnivores, or omnivores.

Objective 27

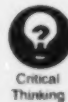
Assignment Sheet 3—Identify Wildlife You See in a Certain Time Span

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Ten plant species are listed.	_____
• Ten animal species are listed.	_____
• Location and time span noted.	_____
• Assignment is neat and legible.	_____
• Assignment was completed on time.	_____

Basic Skills



Introduction

Most people know what they want to see. They select a location that has it. Some people want to see animal wildlife. Others may want to see wildflowers, waterfalls, or rock formations. If what they want to see is available in the local area; little travel will be needed. For example, if you want to see squirrels, a local wooded area or park with a squirrel population will be satisfactory. If a species is not available locally, such as polar bears, it may be necessary to identify the species habitat and travel to that location.

Wildlife varies from region to region and state to state. Some animal wildlife is migratory and may move as season's change. In this assignment you will have an opportunity to learn about the types of plant and animal wildlife in your area.

Suggestions for successful completion of this assignment:

"Looking" at the right time is important. Plants grow and flower in certain seasons. Animals follow daily and seasonal cycles. Some animals are active during the day; others, at night in the dark. Other animals are active at dusk or dawn, such as a deer. Many people find it is best to observe animals in the early morning or late afternoon. This when most animals are most active. During midday, after they have found plenty to eat, wildlife animals are resting or caring for their young.

Animal wildlife can be studied by observing an animal or evidence that the animal is in the area. All people know when they see an animal. Unfortunately, many people may not know the species of the animal. This requires study and learning the major characteristics of the animal species. Getting literature that has pictures of animal wildlife in the local area is a good approach.

Assignment Sheet 3

Signs (evidence that an animal has been in the area) are often used to determine if animals are around. Most animals leave signs unique to their species. A few common signs include:

- Footprints — tracks left by animals in mud, snow, sand, or soft soil.
- Scats — droppings (manure or dung) left by animals. Species typically have unique shapes and sizes of pieces of scats.
- Antlers — used to distinguish between species that have antlers
- Skins — snakes and other reptiles may leave skins
- Shells — remain after an animal has died; shells of eggs after hatching
- Odors — easy to smell (example: skunk)
- Feathers and hair — small amounts of the materials that cover the animal's body
- Physical evidence — animals may scratch in the earth, gnaw on tree bark, build nests, and leave chewed-up food remains
- Nests and homes — some animals build nests and other forms of homes
Examples: Beavers — dams, squirrels and birds — nests, and prairie dogs — burrows
- Color — all animals have distinctive color patterns

You will be more successful in watching animals if you consider what is needed to see the animal. Here are a few tips on getting to see animal wildlife.

- Move slowly and quietly — noise frightens animals
- Sit still — makes you less obvious to an animal
- Stalking — following the tracks or other sign
- Go where animal is likely to be found — know the habitats and cycles of an animal; likely to be near food and water
- Use bait — get animals to frequent an area
- Use camouflage — blend into surroundings
- Use blinds — conceal yourself from animals

You need to be prepared for a safe and enjoyable experience when viewing wildlife. Here are a few pointers on having a good experience.

- Dress properly — Clothing should be comfortable and appropriate for the weather. Wear shoes that fit well and are comfortable for walking.
- Take insect repellent — Use repellent to keep pests off of arms, legs, and other areas.
- Take a map — Especially if you go into an area that is remote.
- Assess the weather — Check the weather report. Sudden changes in weather can leave you unprepared.
- Take water and food — Plenty of water should be on hand.
- Take binoculars — Helps to see animals close-up.
- Take a camera and note pads — You may want to record your observations for future viewing.
- Booklets — A small field guide describing plant and animal wildlife will be useful.
- First Aid Kit — Take a simple first aid kit in case of snakebite or accident.
- Communication plans — Leave word with a person who does not go with you as to where you will be.
- Leave an area as you found it — Do not take flowers, rocks, animals or other living or nonliving materials from area.

Assignment Sheet 3

Directions

1. Choose an area inhabited by wildlife.
2. Note that location.
3. Identify the wildlife species that you see there.
4. Continue to observe until you identify ten plant species and ten animal species.
5. Note the date and time span that it took you to observe the species in that location.

Assignment Sheet 3

Location: _____

Date: _____ Time Span: From _____ To _____

Plant Wildlife Species Observed:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Assignment Sheet 3

Location: _____

Date: _____ Time Span: From _____ To _____

Animal Wildlife Species Observed:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Objective 28

Assignment Sheet 4—Compile a Profile
of a Wildlife Species

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Profile is complete	_____
• Information presented is accurate	_____
• Report is interesting	_____
• Assignment is neat and legible	_____
• Assignment was completed on time	_____

Basic Skills



Reading



Writing



Science

Critical
Thinking

Technology

Introduction

Just like humans, wildlife are consumers of natural resources. They need food, water, and shelter to survive. By understanding their needs, we can minimize the dangers to wildlife populations and establish good management practices that support and protect wildlife.

Directions

Using books and periodicals from your local or school library, and articles found in on-line computer services, compile a detailed profile about a wildlife species that you have selected to study. Your profile should be one to two pages and should include the following information:

- Species of wildlife
- Description of wildlife
- Habitat requirements, including feeding and cover requirements
- Reproduction characteristics
- Role of species in the environment
- Federal legislation that protects species (if any)
- Future outlook of species
- Bibliography—Sources of information for profile

Be prepared to present a brief report of your findings in class.

Objective 29

Assignment Sheet 5—Make Management Decisions
Concerning a Deer Herd

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Student displayed serious effort at project and its goals	_____
• Assignment was completed on time	_____

Basic Skills



Reading



Writing



Mathematics



Science



Critical Thinking

Introduction

What to wear, what to eat, and what to watch on television are examples of decisions that most of us make daily. Many decisions will take more effort than those we deal with on a daily basis, and some decisions will be made based on our own personal beliefs and experiences. Perhaps the most important skill we learn and develop is the ability to evaluate and choose the best alternatives for a given situation (decision making).

Directions

In this activity you will be asked to design a one-year plan for an expanding deer herd. You will determine your own individual plan and then, in conjunction with a team of classmates, you will formulate a group plan. In both cases, you will be asked to explain to the class why you made the decisions you did. There is no one "right" answer in this exercise. But your answers will reflect your own beliefs and budgetary outlook.

You are the manager of a wildlife refuge. There is a herd of 200 deer on the refuge. This herd will expand at the rate of 200 deer per year. The refuge can support only 200 deer. Since the carrying capacity has been reached, the rates of disease and starvation are increasing. Farms surround the area and more deer are beginning to forage on these private lands in search of food.

Listed below are several ways to control the deer population. There is only \$100,000 available to spend on this project, however. Devise a plan to manage the 200 surplus deer over the next year. Choose options, add the total costs, and stay within the \$100,000 budget.

Option A: You can buy a plot of land adjoining the refuge for \$50,000 that will support 50 deer.

Assignment Sheet 5

- Option B: You can improve habitat by planting shrubs to provide food and cover. For \$50,000, you can accommodate 100 deer; \$80,000 will provide for 120 deer; and \$90,000 will provide for 130. Beyond this amount additional moneys for habitat does not add a significant number of deer.
- Option C: You can hire professional game handlers to trap and relocate deer at a cost of \$600 per deer.
- Option D: You can hire professional hunters to remove the deer at a cost of \$150 per deer.
- Option E: You can purchase corn to supplement the deer's natural browse, at a cost of \$300 per deer.
- Option F: You can open the refuge to recreational hunting to licensed hunters who will remove the surplus deer. The cost of hunter education and law enforcement is \$20,000 per year, or \$100 per deer.

Use the following four grids to determine your deer management plan. Choose options from the list above and write the letter of the options chosen in the space provided. For example, if you pick Option A, "Expand Habitat" write "A" in the top blank space of the left column. Fill in the other blanks of the grids with the amount of money for that option and number of deer managed by that option. When you have finished listing your options (you do not have to pick five, but can use one or two or as many as you like), total the columns to see how much of the budget has been used and if you have managed the necessary number of deer. The first two grids are for practice. Use the third grid to develop your individual plan and the fourth for your group's plan.

Assignment Sheet 5

Practice Grid #1

Option(s) Chosen	Amount of Budget Used	Number of Deer Managed
Option # _____		
Option # _____		
Option # _____		
Option # _____		
Option # _____		
TOTALS:	\$	

Practice Grid #2

Option(s) Chosen	Amount of Budget Used	Number of Deer Managed
Option # _____		
Option # _____		
Option # _____		
Option # _____		
Option # _____		
TOTALS:	\$	

Practice Grid #3 (Your Plan)

Option(s) Chosen	Amount of Budget Used	Number of Deer Managed
Option # _____		
Option # _____		
Option # _____		
Option # _____		
Option # _____		
TOTALS:	\$	

Practice Grid #4 (Group Plan)

Option(s) Chosen	Amount of Budget Used	Number of Deer Managed
Option # _____		
Option # _____		
Option # _____		
Option # _____		
Option # _____		
TOTALS:	\$	

Objective 30

Assignment Sheet 6—Analyze Current Reports Concerning Wildlife Management

Name _____ Overall Rating _____

Date _____

Evaluation Criteria**Rating**

- Directions have been followed. _____
- Evidence of research is documented. _____
- Content is relevant and well organized. _____
- Report is neat and eligible. _____
- Assignment was completed on time. _____

Basic Skills

Reading



Writing



Science

Critical
Thinking

Technology

Introduction

Throughout this study of natural resources, you have been asked to research and report on a variety of subjects according to material being covered in the specific units of instruction you are studying. In this assignment you will be researching a topic relevant to wildlife management.

Directions

Use books and magazines from your local or school library and/or resources found in on-line computer services to research the U.S. Fish and Wildlife Service's project of reintroducing the Grey wolf to the mountains of the United States.

Note: For help in finding recent periodicals concerning the USF&WS's plan to reintroduce the wolf to the mountain states, consult the Reader's Guide in your school or local library. Also, review USF&WS's web site at www.fws.gov.

Based on the material you find, write a report outlining the reason why the U.S. Fish and Wildlife Service wanted to reintroduce the wolf to the mountain states, and how the landowners in those states reacted. At the end of your report, draw your own conclusions about how to resolve this dilemma.

Note: There have been suggestions — although they are rooted in the pitched emotions of the dispute between Mountain state ranchers and the USF&WS — that if the wolf was to be reintroduced into the ranch country of the West, Congress should also mandate the Eastern Timber wolf be reintroduced into Central Park in the middle of New York City. What is your reaction to this? Why?

Your instructor will provide you guidelines explaining the format of the finished report.

Objective 16

Assignment Sheet 1—Lay Out and Identify Ways to Improve a Local Habitat

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Design is accurate	_____
• Improvements are appropriate	_____
• Assignment is neat and legible	_____
• Assignment was completed on time	_____

Basic Skills



Reading



Science



Critical Thinking

Introduction

Even in the most urbanized setting, there is a certain amount of wildlife, whether it be birds, small rodents, fish, or amphibians. So, too, any setting can be improved to favor the species present by improving natural cover and food and water resources. This assignment will help you become aware of things you can do in your local surroundings to improve natural habitat for wildlife species already present, and activities in which you can engage to attract additional species to your area.

Directions

Draw the layout for either your school and school grounds or your home and surrounding grounds or land. Add details to your plan of ways to improve that habitat to attract wildlife. Remember the four basic components of a habitat (Objective 2). You may need to research about the wildlife you are trying to attract to find out what they like and need in their habitat.

Objective 17

**Assignment Sheet 2—Develop a Management Plan
for a Farm Pond for Sport Fishing**

Name _____ Overall Rating _____

Date _____

Evaluation Criteria**Rating**

- Directions have been followed _____
- Student displayed serious effort at project and its goals _____
- Report and drawings evidence cognitive grasp of information needed for farm pond management. _____
- Report is well-written, neat, and legible _____
- Assignment was completed on time _____

Basic Skills

Reading



Writing



Mathematics



Science

Oral
Communication

Interpersonal

Critical
Thinking**Introduction**

Many farms and suburban homes are located near ponds built for livestock watering or upstream flood control. In many cases, these bodies of water have not been managed for any particular purpose, therefore, they do not contain significant populations of game fish. In addition, many are not accessible for those who might want to fish. This exercise can be accomplished by an individual or as a class project with the help of wildlife biologists or land-grant university aquatic specialists and literature from various state agencies concerned with sport fisheries.

Directions

Using a pond selected by you or your instructor, determine a game fish you wish to cultivate for sport fishing in that pond. Study the habitat needed for that fish, and evaluate the pond for its ability to provide that habitat. Make recommendations on what actions are needed to improve the game fish habitat of the pond selected. Use the following list of questions to work your way through a comprehensive management plan for your selected pond. Once you have studied and answered the following questions, write a report describing the current condition of the pond, what habitat it provides and what needs to be done to improve its habitat for the game fish you selected. Also, detail with drawings and maps what construction or other management activities you would accomplish in your quest to make this pond an attractive sport fishing body of water.

Assignment Sheet 2

Pond Management Survey

1. What are the overall dimensions of the pond?

Length _____ Width _____

Depth _____ Acreage of surface area and volume _____

2. What is the current use of the pond?

3. Describe the land surrounding the pond and how it affects the pond's water supply and clarity. (Is there silt runoff? What is the watershed of the pond? Is there livestock grazing allowed on pond banks? Are there open gullies feeding the pond? Does the pond catch runoff water from grassed pastures?)

4. What are the predominant fish species found in the pond?

5. Is there an abundance of water and snapping turtles in the pond?

6. Describe the depth of the pond's water near the shoreline. (Shallow banks gradually sloping into deeper water, which allows for aquatic vegetation, or steep drop offs into deeper water).

Assignment Sheet 2

7. Does the pond's water level show evidence of stability or are there wide annual fluctuations?

8. What cover and shelter for fish is there in the pond, and where is it located?

9. What shoreline vegetation is available, and what food sources are there for game fish?

10. Are there roads or access paths to the pond? Would the pond require a float tube or boat to fish it?

11. What are your state's regulations concerning pond renovation before state-sponsored fish can be stocked in a private pond?

12. What other species of wildlife are evident in abundance on, in, or near the pond?

13. What types of artificial cover could you install in the pond to provide nesting and resting areas for game fish and their prey? (Many communities use old tires, Christmas trees, pallets, sunken plastic drums, etc. as artificial reefs and nesting areas in public fishing areas.)

Objective 18

Assignment Sheet 3—Identify Ways to Improve
a Wetland Habitat

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Answers reflect cognitive grasp of information	_____
• Assignment is neat and legible	_____
• Assignment was completed on time	_____

Basic Skills



Reading



Science

Critical
Thinking

Introduction

Wetlands are a prime source of food, water, and cover for many wildlife species. As with most habitats, however, some improvements can be made to enhance the carrying capacity of most wetlands either through maintenance and protection, or physical changes such as removing excess plant growth etc. to provide "edges" and open space. This assignment asks you to identify ways to improve various wetland "problems."

Directions

Using the information presented in this unit, determine the proper improvements to be made to the following wetland habitat conditions.

1. The wetland is dry part of the year.

2. The wetland receives excess flooding during the spring.

3. Grazing livestock are polluting the area.

4. Part of the wetland is overgrown with no open water.

Objective 19

Assignment Sheet 4—Determine the Carrying Capacity of a Rangeland Habitat

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Calculations are accurate	_____
• Assignment was completed on time	_____

Basic Skills**Introduction**

Rangeland stores energy from the sun in various grasses and forbs. Animals harvest that energy by grazing the grasses. Still, a given acreage of rangeland will support only so many of any given species of grazing animal. This exercise will illustrate the difference in a range plot's carrying capacity—or its ability to support given species.

Directions

Using the following information, determine the carrying capacity of a rangeland habitat.



This rangeland has the capacity to support 100 cows.

Livestock to wildlife ratios
1 cow = 1 buffalo
= 2 elk
= 3 deer
= 4 bighorn sheep
= 4 antelope

Assignment Sheet 4

1. What is the capacity of the range for buffalo? _____
2. What is the capacity of the range for elk? _____
3. What is the capacity of the range for deer? _____
4. What is the capacity of the range for bighorn sheep? _____
5. What is the capacity of the range for antelope? _____

Objective 20

Assignment Sheet 5—Survey Wildlife Foods

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Student displayed serious effort at project and its goals	_____
• Report shows cognitive grasp of material	_____
• Report is well-written, neat, and legible	_____
• Assignment was completed on time	_____

Basic Skills



Introduction

All areas, rural, suburban, and urban provide some food suitable for wildlife. Some, of course provide a wider variety of food for many species than others, but even in the middle of the most developed urban area there are food sources for some species of wildlife. In this exercise, you will be asked to survey an area (assigned by your instructor) for the various wildlife foods available.

Directions

Using the list of wildlife foods found in Student Supplement 1, search your assigned area and note the presence of each and its relative abundance. Once you have thoroughly evaluated your assigned area and compiled a list of the foods available, make a list of possible wildlife species that could be present in your assigned area. If there are obvious reasons why some species might not be found in your area even if potential food is available, (i.e., deer more than likely would not be found in the middle of an urban area even if a local park provided food suitable for deer), note reasons why you think they are not present.

Select two species from the list of wildlife in Student Supplement 1 and write a report on your suggestions for improving and providing additional food sources in your assigned area for these species. Turn in your list and written report to the instructor.

Objective 21

Assignment Sheet 6—Survey Non-Game Birds at a Feeding Station

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Student displayed serious effort at project and its goals	_____
• Report shows cognitive grasp of material	_____
• Report is well-written, neat, and legible	_____
• Assignment was completed on time	_____

Basic Skills



Reading



Writing



Science



Critical Thinking

Introduction

Numerous song birds and other non-game birds are found in abundance in many urban, suburban, and rural areas. A sampling of these species can be taken by observing an established bird-feeding station in early morning and late afternoon hours during cold winter weather—especially if there is snow cover or an approaching storm. Learning to identify such birds is relatively easy using various state wildlife agency identification guides or consulting with *The Audubon Society Field Guide to North American Birds* (Western and/or Eastern Region editions). This assignment will give you the opportunity to learn what non-game bird species are prevalent in your area and a chance to learn more about their habitat.

Directions

Station yourself at an established bird feeder filled with a bird feed mix of various seeds for two consecutive days at the same time (either early morning or early evening) for at least one hour. Using an appropriate bird identification guide, record the various species visiting the feeder and record the largest number of each species you observe at any one time on or near the feeder.

Once you have compiled your list, consult with the appropriate identification guide, or the Audubon guide mentioned above, to determine what habitat each of the recorded species require and what their native range is.

Based on your findings, write a report detailing your observations at the bird feeder. Include examples of nearby habitat for each species (i.e., cedar trees for cardinals, open areas with fruit and seed for bluebirds, etc.). And, make suggestions based on your observations of the area near the bird feeder for improving habitat for the species you observed.

Assignment Sheet 6

Bird Feeding Station Observation Log

Date: _____ Time observed: From _____ To _____

Date: _____ Time observed: From _____ To _____

Location of bird feeder: _____

Species

Largest number seen at one time

Objective 22

Job Sheet 1—Increase Hummingbird Habitat

Name _____ Attempt Number _____

Date _____ Overall Rating _____

Evaluation Criteria

Rating

- Directions have been followed _____
- Student actively took part in project _____
- Appropriate flower species planted _____
- Hummingbird feeders obtained and distributed _____
- Hummingbirds observed/photographed _____
- Worked cooperatively with others to reach a common goal _____
- Project summary was thorough and well written _____

Basic Skills



Introduction

With 15 species of hummingbirds common to many areas of North America, this non-game bird is relatively easy to attract—sometimes in large numbers. This assignment will allow you to improve hummingbird habitat and study the needs of this tiny, colorful bird.

Instructions

Before beginning this activity, your instructor will divide the class into teams of 3-4 students. As a team, assign specific tasks to each team member so that everyone has an equal opportunity to contribute to this activity. Project summaries should be submitted by each team and team members should be prepared to discuss findings in class.

Your instructor will observe individual and group activities and rate your performance using the evaluation criteria.

Tools,
Equipment,
and Materials

- Flower species used by hummingbirds
- Garden tools
- Hummingbird feeders or materials to build feeders
- Basic tool kit
- Camera, flash attachment, and film

Procedure

- ☐ 1. Obtain information available from land-grant university wildlife biologists or state wildlife conservation personnel concerning the hummingbird and its habitat.
- ☐ 2. Study the nesting habits of the hummingbird, and make notes concerning their needs.

Job Sheet 1

- ☐ 3. Purchase hummingbird feeders or obtain plans or kits to build the feeders.
- ☐ 4. Construct hummingbird feeders according to plans (if necessary).
- ☐ 5. Install the hummingbird feeders in areas most likely to attract these tiny birds.
- ☐ 6. Observe the hummingbirds and photograph the birds during their visits to your flower "plantings" and hummingbird feeding stations.
- ☐ 7. Prepare a two-page summary of the project (as a team), including the following:
 - Basic needs of the hummingbird
 - Nesting habits of the hummingbird
 - Flower species planted by team
 - Locations of plantings and feeding stations
 - Photographs of hummingbirds at plantings and/or feeder stations
 - Benefits of project to hummingbird habitat improvement

Evaluator's Comments: _____

Objective 11

Assignment Sheet 1—Interpret Graphs on Future Trends in Outdoor Recreation

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Answers are correct	_____
• Assignment was completed on time	_____

Basic Skills



Reading



Mathematics

Introduction

Statistics abound in all areas of life. The compilation of statistics gathered through surveys and research projects is usually displayed graphically for easy interpretation. This exercise will enhance your ability to read and interpret graphs. For more detailed information on outdoor recreation activities refer to *Outdoor Recreation in the United States: Results from the National Survey on Recreation and the Environment*, a report from the USDA Forest Service available on-line at www.srs.fs.usda.gov/trends.

Directions

Using the graphs on the following pages answer these questions.

1. What was the population of the United States in 1980? _____
2. What was the population of the United States in 2000? _____
3. What will be the population of the United States in 2050? _____
4. What will be the population growth of the United States between 2000 and 2030? _____
5. Considering that 94.5% of people participate in outdoor recreation, how many more people will participate in 2030 vs 2000? _____
6. What is the most popular outdoor recreation activity? _____
7. Approximately how many participants enjoy sightseeing? _____
8. What is the most popular traditional outdoor activity on public lands? _____

Assignment Sheet 1

9. What traditional outdoor activity on public lands has the least participation? _____
10. Approximately how many participants enjoy swimming activities?

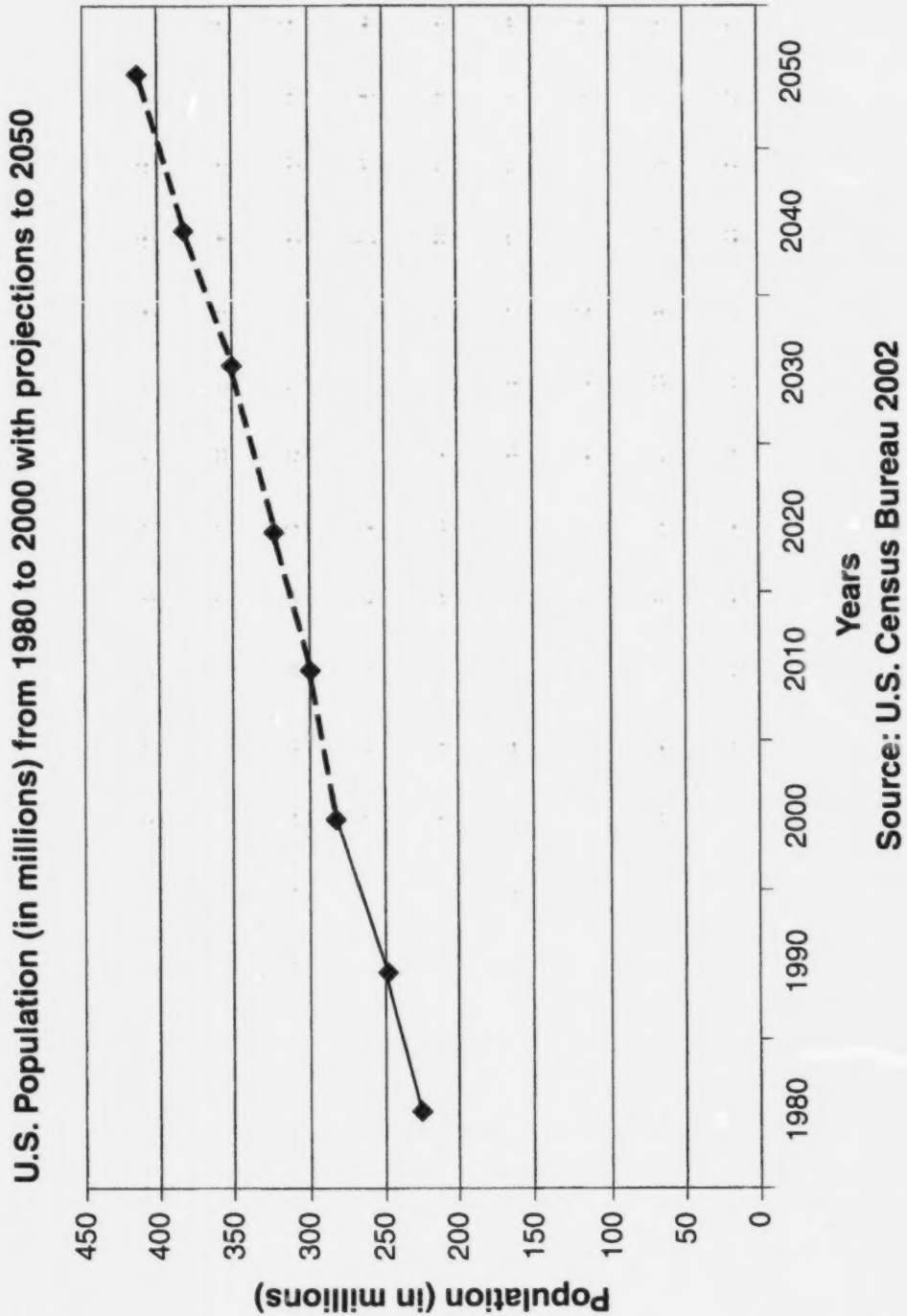
11. What percent of participants visited national parks on their last visit to an outdoor recreation site? _____
12. What outdoor recreation site did most participants last visit?

13. Over 35% of families whose income is between \$_____ to \$_____ participate in camping.
14. Which family income level participates the least in camping activities?

15. Which family age group participates the most in camping activities?

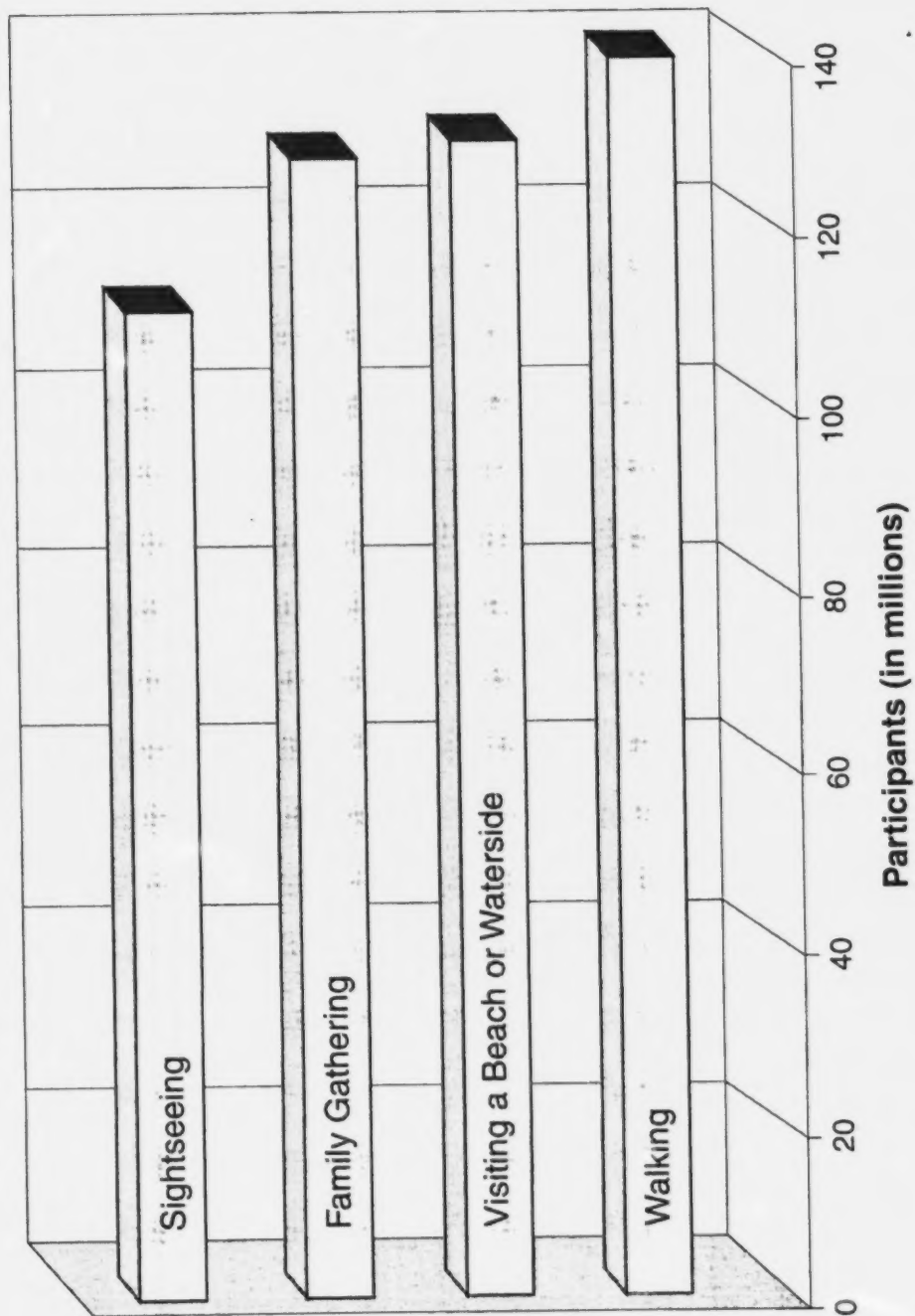
16. Which family age group participates the least in camping activities?

17. What three services or aids would most enhance the outdoor recreation experience of persons with disabilities?
 - a. _____
 - b. _____
 - c. _____



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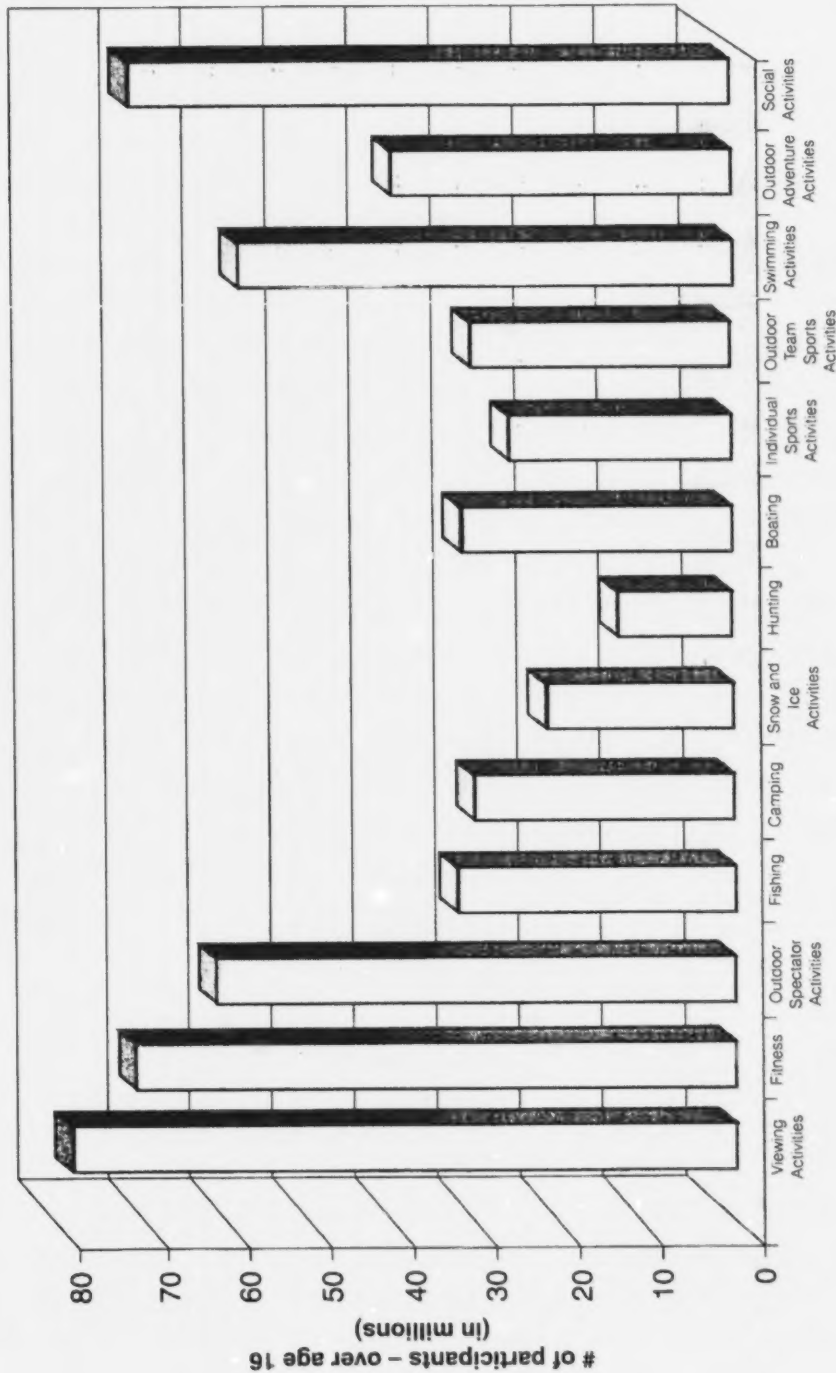
The Four Most Popular Outdoor Recreation Activities



Source: Outdoor Recreation in the United States, 1997

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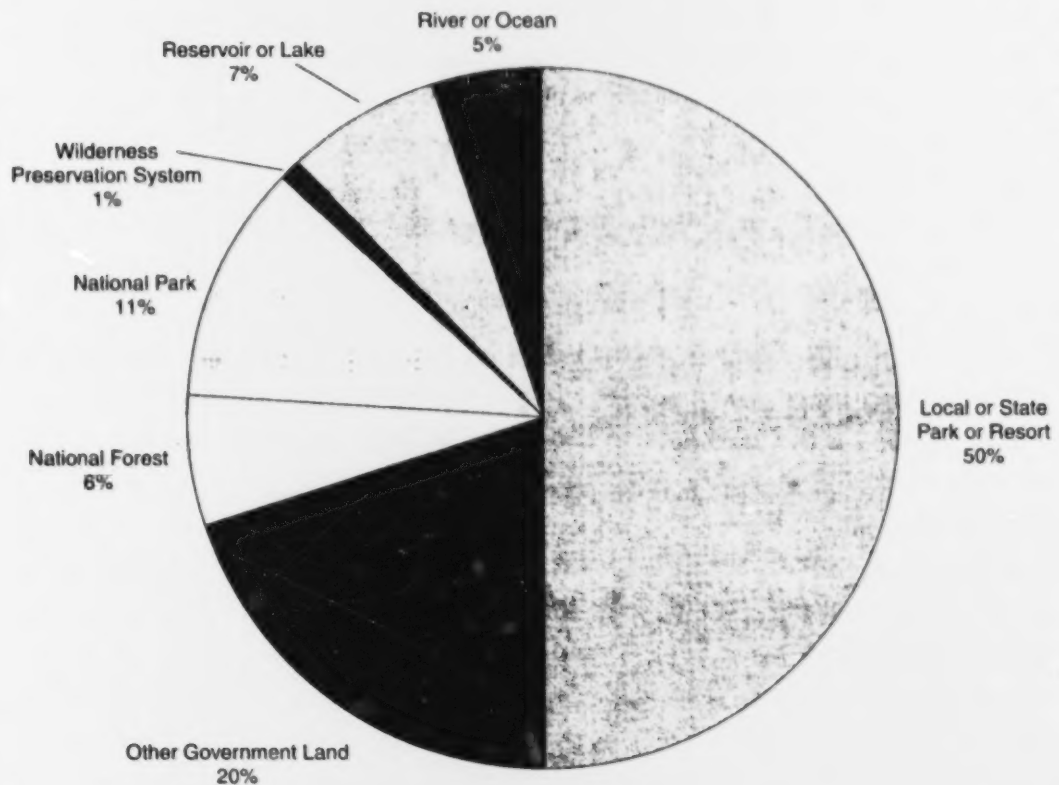
Traditional Outdoor Activities on Public Lands



Source: Outdoor Recreation in the United States, 1997

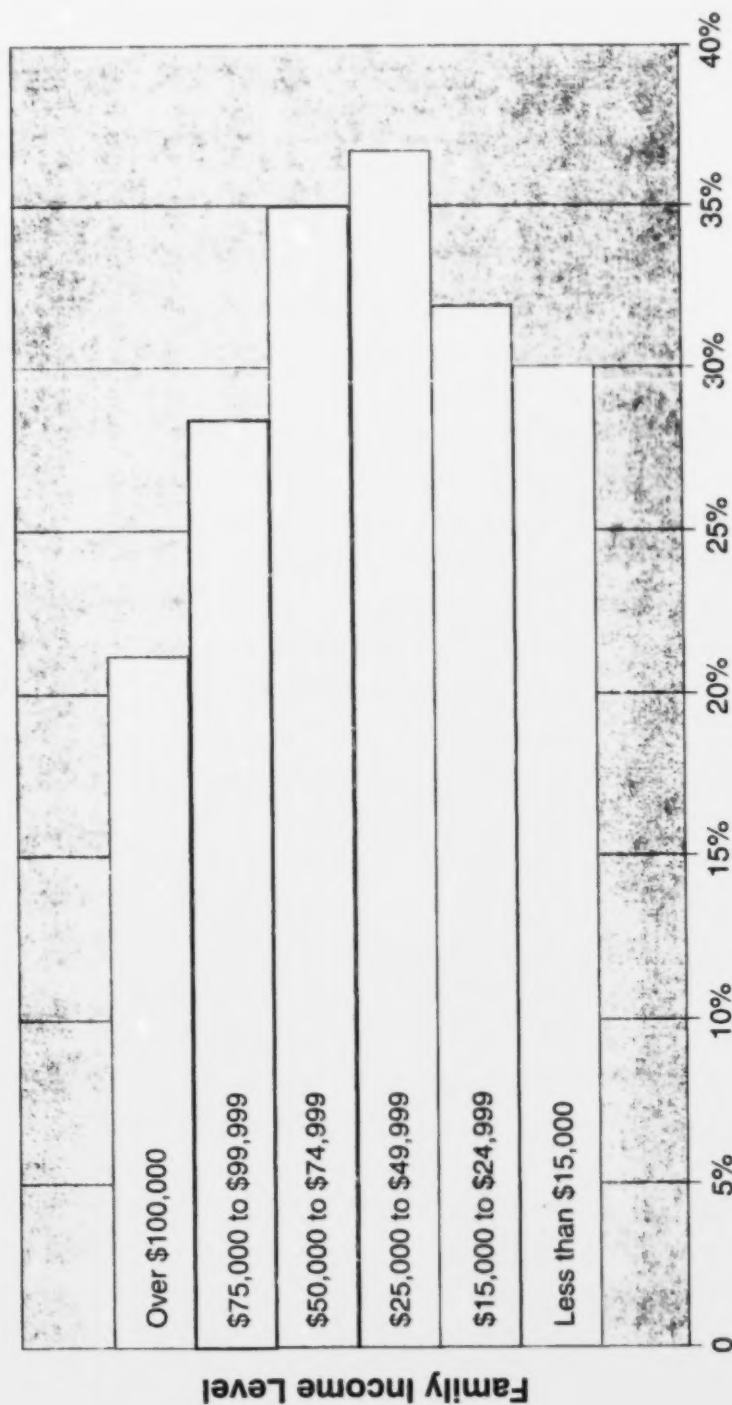
Assignment Sheet 1

Percentage of Last Outdoor Recreation by Type of Site Visited

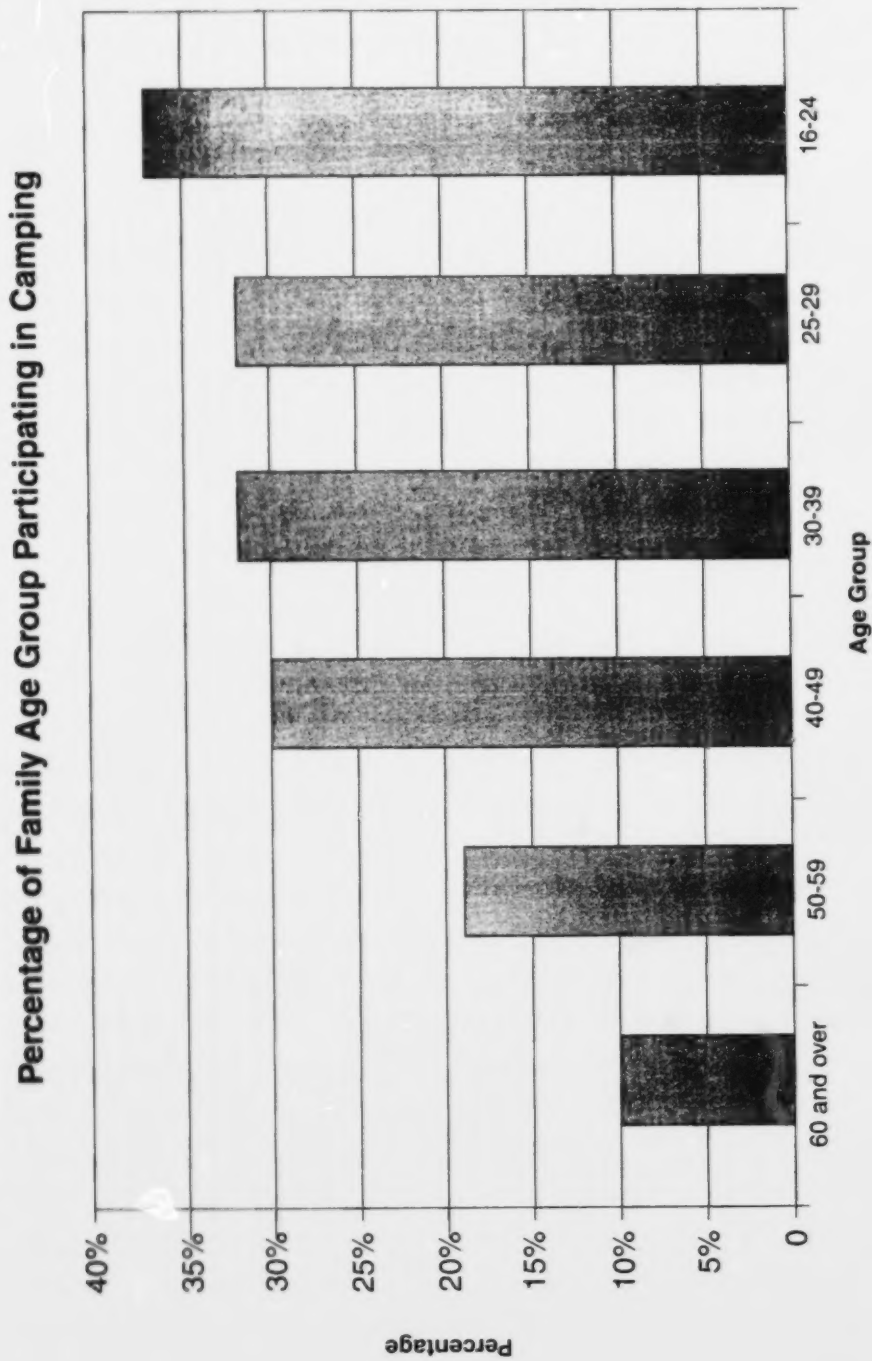


Source: Outdoor Recreation in the United States, 1997

Percentage of Family Income Level Participating in Camping

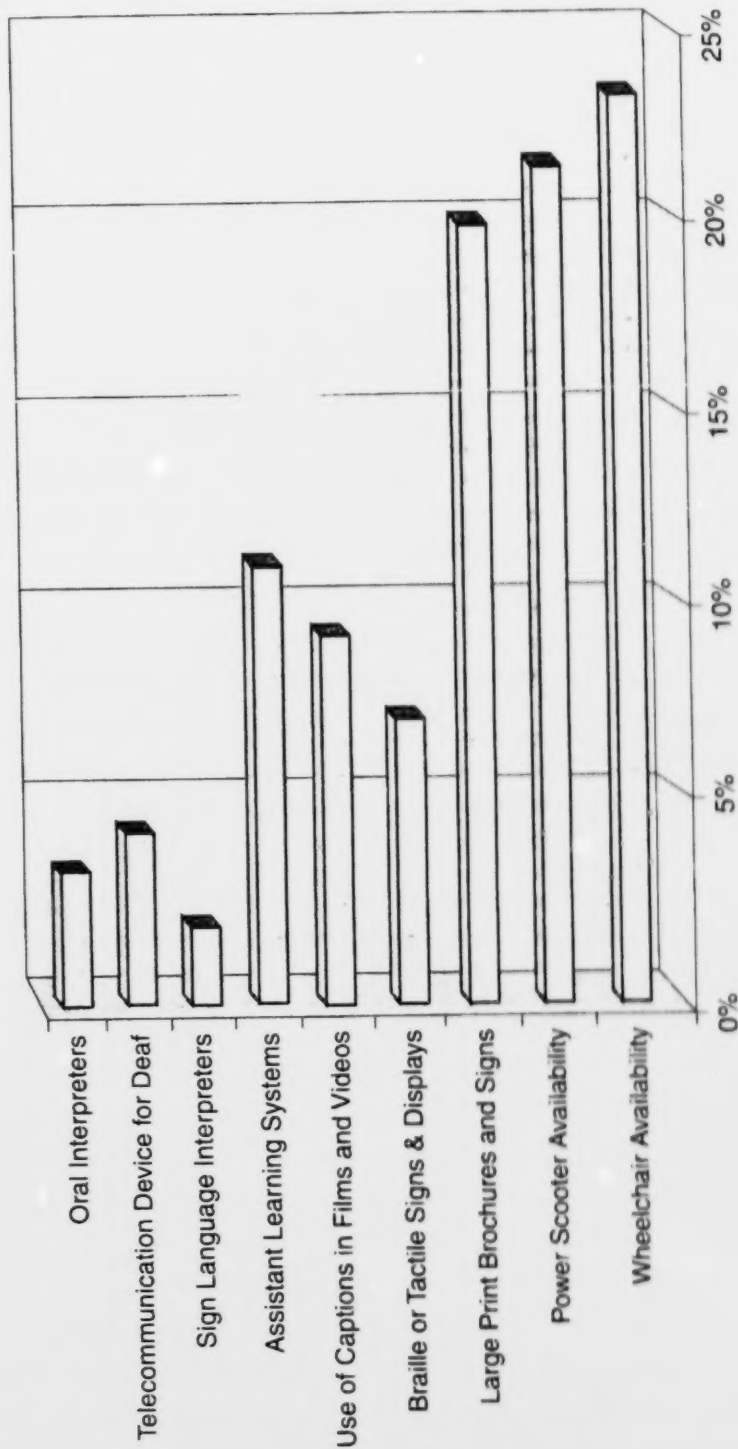


Source: Outdoor Recreation in the United States, 1997



Source: Outdoor Recreation in the United States, 1997

Percentage of Persons Over Age 16 with Disabilities Indicating Specific Services or Aid Would Enhance Their Outdoor Recreation Experience



Source: Outdoor Recreation in the United States, 1997

Objective 12

Assignment Sheet 2—Identify Outdoor Recreation Activities and Facilities Available Locally

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Ten local outdoor recreation areas are listed	_____
• Facilities are correct for each	_____
• Questions are answered appropriately	_____
• Assignment was completed on time	_____

Basic Skills



Introduction

Every community, whether rural, suburban or urban, has access to some forms of outdoor recreation. This exercise is designed to make you aware of the part outdoor recreation plays in your local area. By cataloging outdoor recreation within a 30 mile radius of your home, you can begin to see the recreational and economic potential such activities have for you and your community.

Directions

List ten (10) outdoor recreation activities that are available to you within thirty miles of your home. Also describe the facilities available for each. Then answer the questions that follow.

Local Outdoor Recreation Activities	Facilities Available

Assignment Sheet 2

1. Of the outdoor recreation activities listed, which ones do you participate in?

2. How often do you participate in them? _____

3. What outdoor recreations do you think you would like, but you have never tried?

4. What outdoor recreations are not available locally? _____

5. Are there any outdoor recreations that are available locally, but that are too crowded or too expensive for you? _____

Objective 13

Assignment Sheet 3—Evaluate a Local Outdoor Recreation Site

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Evaluation is accurate	_____
• Recommendations indicate cognitive grasp of subject	_____
• Assignment is neat and legible	_____
• Assignment was completed on time	_____

Basic Skills



Reading



Writing



Critical Thinking

Introduction

Parks and recreational areas abound throughout the United States. Some are more successful than others at meeting public demand for "quality time" outdoors. In this exercise you will be asked to visit a park or recreational area to survey its various offerings and how they might serve the individuals who frequent the area.

Directions

Visit a local park or recreational site. Survey the area and its facilities. Rate the site according to the following criteria by placing an "X" in the box under your selection. Then make recommendations on ways to improve the site.

Assignment Sheet 3

	Excellent	Acceptable	Unacceptable	Not present
Natural Beauty				
Amount of crowding				
Sanitation facilities				
Parking availability				
Available information				
Picnic areas				
Cultural events				
User fees				
Concessions				
Organized sports				
Guided activities				
Physically challenged access				
Others (listed as needed)				

Recommendations for improvement of site:

1. _____

2. _____

3. _____

4. _____

5. _____

Objective 14

Assignment Sheet 4—Make a Presentation About an Outdoor Recreation Activity

Name _____ Overall Rating _____

Date _____

Evaluation Criteria**Rating**

- Presentation was well planned, informative, and interesting _____
- Length was 5-10 minutes _____
- Spoke in a clear, concise manner _____
- Used appropriate eye contact, gestures, and posture _____
- Used visual aids effectively _____

Basic Skills**Introduction**

Outdoor recreation provides many opportunities for fun, profit, and improved mental and physical health. Consequently, many forms of outdoor recreation carry with them risks of injury, etc. Select an activity related to outdoor recreation and make an oral presentation concerning it. In this manner, you will not only learn more about outdoor recreation, but you will teach others about the benefits and precautions related to such activity.

Directions

Choose an outdoor recreation activity and then prepare a 5-10 minute presentation on your activity. The presentation may be one of the following:

- Oral presentation to class/instructor with at least one visual aid such as tools or equipment used for activity, Power Point about activity, poster of safety rules, etc.
- Videotape presentation about your activity

Presentation Suggestions

1. Proper use of the special equipment needed for a particular outdoor recreation activity
2. Safety demonstration for a particular outdoor recreation activity
3. First aid demonstration
4. Your favorite outdoor recreation activity, why you like it, and what skills and equipment are involved

Objective 15

Assignment Sheet 5—Plan and Design a New Outdoor Recreation Area

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Plan shows imagination and includes practical and useful ideas	_____
• Area designed for maximum comfort, convenience, and enjoyment, and includes accessibility for physically challenged	_____
• Drawings or pictures clearly represent design features	_____
• Summary is informative and clearly describes plan	_____
• Assignment was completed on time	_____

Basic Skills

Reading



Science

Oral
CommunicationCritical
Thinking**Introduction**

Trends in outdoor recreation reflect an interest by approximately 90% of the public in some type of activity. Each year millions of people visit national, state, and/or local parks. As you learned in Objective 6, there are several considerations when selecting an outdoor recreation site. These considerations also apply when you are planning and designing a new outdoor recreation facility.

In this assignment you will have the opportunity to be creative by designing what you think would be an ideal camping facility in a park.

Directions

Consider yourself a park manager. You are developing a new area for camping. It is your responsibility to plan and design the area for maximum comfort, convenience, and enjoyment.

Review the information sheets to determine the facilities and equipment needed for camping. Analyze what people want in a camping area, and why they enjoy camping. Also, consider features that will make your area accessible for the physically challenged. Most of all, use your imagination.

Draw or find pictures to show your design, and write a brief summary of your plan. Mount the pictures and summary on a poster board for display. Be prepared to present your plan and design in class.

Objective 16

Assignment Sheet 6—Give Accurate, Easy-to-Follow Directions

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Assignment is neat and legible	_____
• Assignment was completed on time	_____

Basic Skills



Reading



Writing



Critical Thinking

Introduction

All states and many cities are making an effort to increase tourism to import dollars into their economies. Given this influx of tourists to many areas, those people involved in outdoor recreation careers will many times be asked for directions to local facilities and attractions. This assignment will give you a chance to work on giving efficient, easy-to-follow directions. Remember, some people have no idea of directions on a compass (North, East, West, South), and only grasp "right" and "left," "forward" and "back."

Directions

Give short, easy-to-follow directions using the compass directions and distances such as city blocks, stop lights, section lines, landmarks, etc. from your school to the following places:

1. The nearest public library

2. The nearest hospital emergency room

Assignment Sheet 6

3. A good place to fish

4. A good place to eat barbecue

5. The county courthouse

Directions

Give short, easy-to-follow instructions using "right", "left", "at an angle", etc. and distances such as blocks, miles, stop lights, section lines, etc. from your school to the following places:

1. A lake on which one can water ski

2. A historical monument or marker

3. The quickest route leading to the nearest Interstate highway

Assignment Sheet 6

4. A place for a quiet picnic

5. An airport

Objective 17

Assignment Sheet 7—Evaluate Conflict Resolution Scenarios

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Directions have been followed	_____
• Answers show insight into human behavior and judgement of actions to take	_____
• Assignment is neat and legible	_____
• Assignment was completed on time	_____

Basic Skills



Reading



Writing



Critical Thinking

Introduction

As more and more people take advantage of the endless opportunities of recreation in the outdoors, more and more people of different outlooks, likes, and dislikes come in contact with one another. The result: conflicts arise. This assignment will acquaint you with some typical conflicts in various outdoor recreation scenarios.

Directions

Read each scenario, consider both sides of the conflict, and answer the question posed in each.

1. You are the caretaker and manager of a federal campground operated by the U.S. Army Corps of Engineers on a large flood control lake. In one of your campgrounds, the teenage son of a family has been left alone with the family's tent camper and is playing a stereo at full volume and practicing with martial arts weapons. When anyone approaches him or even stares in his direction, he assumes a belligerent, threatening, and aggressive stance. Several campers from nearby campsites have complained to you about this individual's behavior and are upset that their "peace and quiet" has been disturbed. You are not authorized to carry weapons and are not trained in hand-to-hand combat. You are an hourly-paid employee in charge of caring for and running the campground. Experience tells you it could be 30 minutes to an hour before Highway Patrol troopers or the county sheriff's department can respond, and the nearest Corps of Engineers enforcement people are 120 miles away. What do you do?

Assignment Sheet 7

2. As the manager of a private, recreational vehicle campground it is your responsibility to assign various campers to the best possible sites available on a first-come, first-served basis, after accommodating campers who have made reservations. You have placed a family group of campers in a series of adjoining campsites to allow them close contact with one another and easy access to the public showers and restrooms. Shortly after they have established their camping equipment and begun to relax, you are informed by an arriving camper the middle site you have assigned to the family has been reserved for her for three months. In addition, the reservation was guaranteed by a payment-in-full check in advance. She is tired from a 12-hour drive, it's too late to find other accommodations in the area, and she is furious her reservations have been ignored. Even after you offer what you consider better campsite, she is still seething and threatening to contact your franchise office—a move which could cause you significant financial problems. What do you do?

3. You are the operator of a canoe concession on a clear, meandering river that offers mild to wild canoe trips for the general public. Once your canoeists make their full-day or half-day trip, they arrive at a widening, quiet part of the river that is crossed by an old county road bridge. The bridge has been used for years by many fishermen who dangle their lines off the bridge into the quiet, deep waters below. Over the past several weeks a number of your clients have complained of anglers harassing canoeists as they glide beneath the bridge. In another instance, a group of youths which included the county sheriff's son, was involved in a bottle throwing incident in which bottles landed in the canoes as they passed under the bridge. Your business depends upon happy customers, and being hassled at the end of the day on a public river doesn't make their mood very positive. The riverbank's terrain and private property lines prevent you from taking canoes out upstream of the bridge. What do you do?

Assignment Sheet 7

4. You are the manager of a 27,000-acre yellow-pine forest recently purchased by your employer, a multi-national wood products company. For years, the land you manage was owned by a local timber company that operated on what you think were outdated management practices that allowed open range cattle on the land and unrestricted access to hunters, anglers, and picnickers. Now, your firm has fenced the perimeter of the forest to prevent cattle from grazing its borders, and your management has instructed you to end unrestricted access to the land. Many of your forest's neighbors grew up hunting on this land, and many of them have run cattle on its hillsides for generations. Access to the land you manage has been taken for granted by the locals for longer than you have been alive. As you cruise the forest inventorying its timber stands you find evidence of deer poaching throughout all months of the year. Also, the fence your firm has built around the forest is regularly cut and unbranded cattle allowed to graze at will. You also have noticed a number of cases of arson in the forest coinciding with confrontations you and your staff have had with locals found on the land without permission. Although the people of the area are outwardly friendly there is a distinct air of lawlessness among them. You are viewed as an outsider. What do you do?

5. As the leader of a youth shelter for abused, neglected and sometimes law-breaking teenagers, you obtain permission from your city officials for your group to clean up an abandoned railroad depot to convert it to a youth recreation center. You plan to use the concrete parking lot as a basketball court, the lobby as a meeting room, and the sidewalks and baggage area for various games such as hop scotch and four-square courts. As you begin work with your teenage crew it soon becomes apparent two homeowners adjacent to your property are not at all pleased with the presence of "troubled" youth in their neighborhood. They harangue you while you work, causing some of the young people to become belligerent in their own defense. This just adds to the conflict. You know the old depot could become a vital resource for the rehabilitation of your young people, and you know the neighbors have a legitimate concern about their property values and potential crime in the area. What do you do about the immediate problem of a confrontation between the neighbors and your youths? What do you do to defuse this situation before someone takes legal action or becomes violent?

Objective 18

Assignment Sheet 8—Explore Career Opportunities in Natural Resources

Name _____ Overall Rating _____

Date _____

Evaluation Criteria	Rating
• Questions were answered appropriately	_____
• Information presented is accurate	_____
• Sources have been cited	_____
• Assignment is neat and legible	_____
• Assignment was completed on time	_____

Basic Skills



Reading



Writing

Oral
CommunicationCritical
Thinking

Technology

Introduction

Throughout your study of natural resources you have been asked to list occupations associated with that area of study. You will now explore the requirements, expectations, and the demand outlook for an occupation associated with natural resources.

Directions

- Select a natural resource occupation to research.
- Research the occupation by:
 - Using resources available from guidance counseling office, school library, or online services
 - Exploring employment opportunities available from many online natural resource sites such as the U.S. Fish and Wildlife Service, U.S. Forest Service, USDA Natural Resources Conservation Service, etc.
 - Interviewing individuals currently working in the chosen occupation
 - Contacting local employers for employment information
- Answer the following questions.
Note: You may want to use additional paper to answer questions.
- Cite all sources of information.

1. What is the occupation of interest?

2. What are the reasons for selecting this particular occupation?

Assignment Sheet 8

3. What are the educational requirements or special training needs required by the occupation?
4. What kind of work experience is needed to be successful in this occupation?
5. What are the earnings or salary that can be expected from this occupation?
6. What are advantages and disadvantages associated with this occupation?
7. What personal skills, interests, and aptitudes are needed to be successful in this occupation?
8. What are the working hours associated with this occupation?
9. What are the working conditions associated with this occupation?
10. What are the possible non-financial rewards and satisfactions associated with this occupation?

Assignment Sheet 8

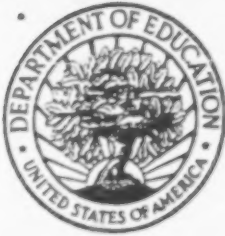
11. What possible occupational advancements or opportunities are associated with this occupation?
12. What is the demand for qualified personnel in this occupation?
13. Where can employment in this occupation be found in the local community or surrounding region?

Sources of information:

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